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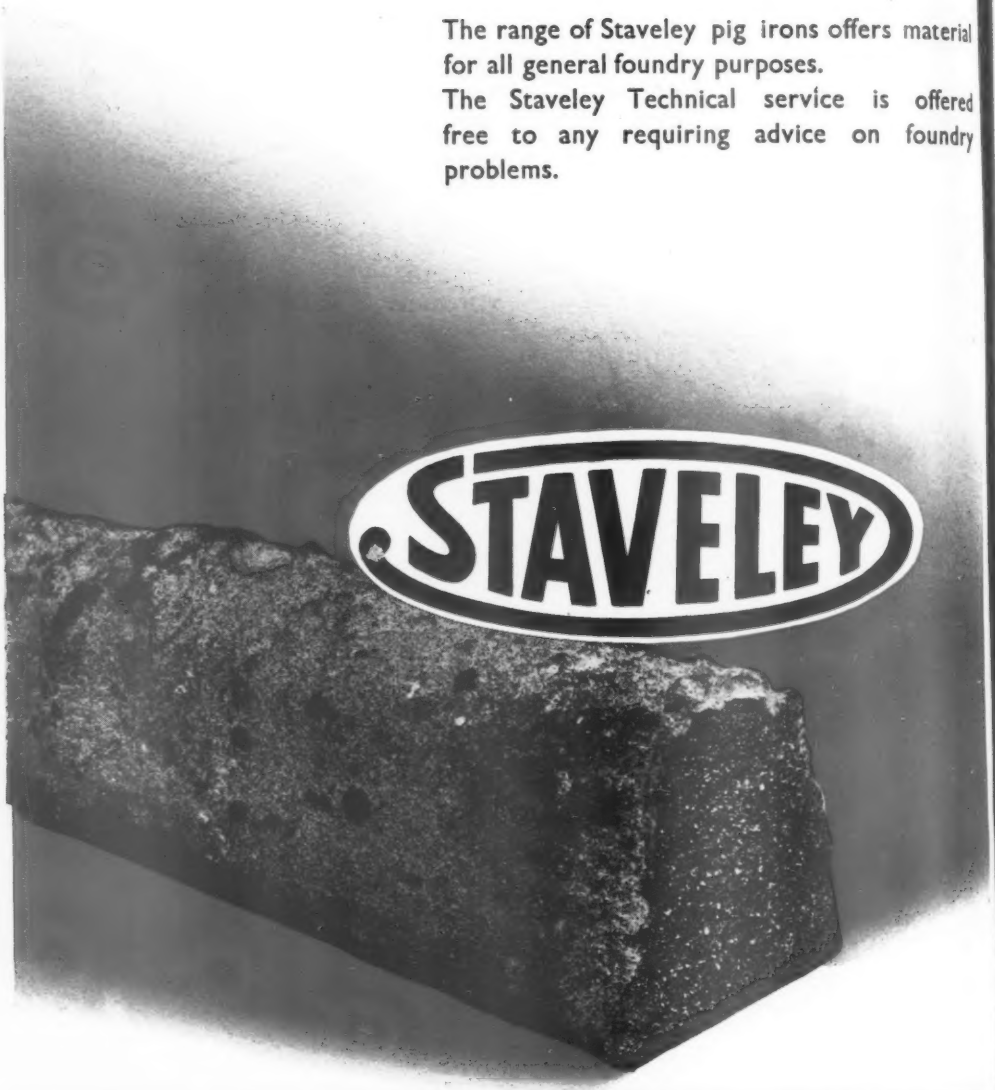

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Promotion or Resignation

It has been noticeable in recent times that there is a tendency for the higher executives, just below board-room rank, to leave the large concerns to accept positions as managing directors of smaller concerns. We do not believe that this is primarily a question of status but rather to assume a position where there is every chance of their efforts being truly reflected in the progress of the company. It is quite correct to state that a departmental manager of a large company is in every way as important as the owner of a smaller business. Indeed, the foremen in dockyards, railway shops and Government factories were always well worthy—on the basis of their great responsibilities—to be entitled to the name of manager. Yet only recently has their real status been accorded.

It is pleasing to record that a number of the larger concerns have recognized the need for rewarding and acknowledging the worth of their major executives by the creation of positions carrying the title of local directors. Others commendably have created a number of subsidiary companies and elected the chief works executives to the Boards thereof. This to our mind is good business, for when these officials have to travel, they can meet the highest executives of their customers or suppliers on equal terms. Such a system gives a chance to the specialist—the metallurgist, physicist, chemist, and so forth—to remove himself from his niche, where his services to the company are only indirectly recognized.

Many Continental firms reserve places on the directorate for those who are associated with finance, to the complete exclusion of both the practical and technical men. We believe that a balance of a number of different types of skills is essential for the proper direction of a large industrial concern. The help that can be given by eminent people who sit on a number of Boards is well appreciated. Their broad experience and wisdom is a great asset, yet it should be leavened by their having as colleagues the leading technicians of the company. This indeed is the policy of most go-ahead companies to-day. How different it is from the first annual dinner of a firm which the Editor joined as a youngster. At the high table interspersed between the financial directors—there was no other type then—were the district salesmen. Birmingham and London took pride of place. Then placed amongst the clerks and typists were the works managers, the steelworks and rolling-mill managers. This typified the policy of the Board of the company and yet, to our mind, it was quite wrong. Thus we make a plea to the large works to create incentives other than direct remuneration for those key men in their employ. Such executives, by the exercise of their skill, contribute a great deal to the well-being of the company. Otherwise, the trend noted earlier will accelerate.

International Foundry Congress

Detailed Arrangements for the June Functions

The completed programme for the June International Foundry Congress organized by the Institute of British Foundrymen (under the auspices of the International Committee of Foundry Technical Associations) has now been issued and details are given in what follows. The main conference week begins with an informal Garden Party on Sunday, June 19, at the Harrow home of Mr. and Mrs. Barrington Hooper and concludes on Saturday, June 25, with an all-day trip to Blenheim Palace, Oxfordshire. In between, each minute of delegates' working time can be employed in committee, at technical sessions, social or sight-seeing functions or works visits. The Congress headquarters is at the Dorchester Hotel, London, W.1. Afterwards, mainly for overseas visitors, there is a choice of two post-Congress tours* (June 26 to July 2)—the first covering the Midlands and Lancashire, and the second Scotland, North East Coast and Sheffield. As usual, while members, guests, and overseas delegates are engaged in committee, technical discussion or works visits there are special functions arranged for their ladies. Again, as usual, the whole Congress is meticulously organized as to detail and only needs co-operation as to punctuality and timing on the part of those attending to make it run like clockwork. This is the first time since 1939 that an International Foundry Congress has been held in this country and there is no doubt it will be well supported. Early registration, application for tickets and, most important, hotel accommodation (the latter to be fixed up privately), is therefore recommended.

Special Notes

All who wish to participate in the Congress or post-congress tours are requested to complete a reply form, and return it as soon as possible, and in no case later than Saturday, May 21, to Mr. G. Lambert, secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3, England, complete with a remittance in payment for the tickets. On receipt of applications from overseas delegates, a registration card will be issued. On arrival in London, this card should be taken to the congress office where it will be exchanged for the programme, tickets, copies of papers, congress badge, etc.; British participants will receive these by post in advance. Urgency of registration is impressed for the following reasons:—(1) Permitted numbers for many events are strictly limited; (2) additional transport cannot be booked at short notice owing to other heavy demands in London during the week of the congress; (3) lists of names of those participating in works visits must be submitted to the management of the respective firms beforehand.

Punctuality.—All the arrangements are worked to a very close schedule and any slight delay may completely dislocate the rest of the day's arrangements. Punctuality is therefore essential and delegates and ladies are requested to attend all functions at least *five minutes* before the advertised times.

Information Bureau.—For the convenience of delegates and ladies, an office will be open daily at the Congress headquarters, the Dorchester Hotel (Crush Hall, Ballroom Entrance), Park Lane, London, W.1, from June 19 to 24. If any information concerning the Congress is required, it may be obtained at the office where a competent staff of officials will be able to help. A representative of Thos. Cook & Son, Limited, will also be there to change travellers' cheques and to give any information required in connection with personal sightseeing, tours, etc.

A special badge will be issued to each delegate and lady attending the Congress.

Hotels.—Owing to the considerable demand made upon hotel accommodation in London, particularly during the week of this Congress, it is absolutely essential that accommodation be reserved well in advance. A complete list of recommended hotels can be supplied. Overseas delegates are recommended to make their hotel reservations as quickly as possible through any office of the Thos. Cook & Son/Wagon Lits organization. British participants should write direct to the hotel of their choice immediately.

Correspondence.—Delegates who wish their correspondence forwarded to them during the period of the Congress should have it addressed:—c/o Institute of British Foundrymen, Dorchester Hotel, Park Lane, London, W.1.

PROGRAMME

(Subject to alteration)

Sunday, June 19:

10.00 a.m. to 3.00 p.m. Registration Office and Information Bureau will be open in the Crush Hall at the Dorchester Hotel, Park Lane, London, W.1. (Ballroom entrance).

2.15 p.m. Coaches leave Ballroom entrance of the Dorchester for a Garden Party by kind invitation of Mr. Barrington Hooper C.B.E., and Mrs. Hooper, at their home, Southward, Mount Park, Harrow.

On return, coaches will arrive at the Dorchester from 6.15 to 6.45 p.m. (Evening free).

Monday, June 20:

9.30 a.m. to 3.30 p.m. Committee and Council Meetings of the Institute of British Foundrymen at the Dorchester Hotel.

10.30 a.m. Sightseeing tour of the West End of London. Arrive at Dorchester Hotel on return at 12.30 p.m. (Delegates and ladies.) Delegates and ladies make their own arrangements for luncheon.

2.15 p.m. Visit to the Royal Mint; arrive Dorchester Hotel on return about 4.30 p.m.; (overseas delegates and their ladies only, limited to 24).

2.30 p.m. Sightseeing Tour of the City of London. Arrive at Dorchester Hotel on return at 4.30 p.m. (Open to overseas delegates and *all* ladies.)

3.45 p.m. Annual general meeting of the Institute of British Foundrymen (members only), in the ballroom at the Dorchester Hotel; evening free.

Tuesday, June 21:

9.30 a.m. Congress opens in the Ballroom of the Dorchester Hotel (all delegates and their ladies). Welcome to the overseas delegates by the president of the Institute of British Foundrymen. Official opening of

*Details of these will be printed in next week's JOURNAL.

the Congress by the Rt. Worshipful the Mayor of the City of Westminster.

Presentation of awards: (*a*) the Oliver Stubbs gold medal; (*b*) the E. J. Fox medal; (*c*) the Meritorious Services medal; (*d*) the British Foundry Medal and Prize, and (*e*) the John Bell Travelling Scholarship.

11.00 a.m. Presidential address by Dr. A. B. Everest.

11.30 a.m. The eighteenth Edward Williams Lecture "Metals Perfect and Imperfect," by Dr. T. E. Allibone, F.R.S.

12.45 p.m. for 1.00 p.m. Buffet luncheon at the Dorchester.

2.30 p.m. Two simultaneous technical sessions: (A) and (B) (see later). Papers 1119, 1120, 1121, and 1122.

5.00 p.m. to 5.30 p.m. Technical film displays.

6.30 p.m. to 7.30 p.m. Reception by Her Majesty's Government at Lancaster House, London, W.1. A member of the Government will receive the guests. (Informal dress.) (Note: The number of invitations to this Reception is of necessity restricted. Ladies will *not* attend this function.)

9.00 p.m. to 11.00 p.m. Reception by the president of the Institute and Mrs. Everest at the Hall of the Fishmongers' Company, London, E.C.4; (all delegates and ladies by invitation), (Note: Delegates attending the Government Reception are also invited to attend this function.) (Evening dress.)

Wednesday, June 22

9.00 a.m. Technical film displays at the Dorchester Hotel prior to the technical sessions.

9.30 a.m. to 5.00 p.m. Meeting of the International Committee on Testing Cast Iron in the Stanhope Room (committee members only).

9.30 a.m. Two simultaneous technical sessions (C) and (D), papers 1123, 1124, 1125, 1126, and 1127.

12.45 p.m. for 1.00 p.m. Luncheon in the Ballroom of the Dorchester Hotel (all delegates).

2.30 p.m. Two simultaneous technical sessions (E) and (F), papers 1128, 1129, 1130, 1131, and 1132.

5.00 p.m. to 5.30 p.m. Technical film displays will follow the technical sessions.

7.30 p.m. for 8.00 p.m. to midnight. "Piccadilly Fare"—informal dinner and cabaret in the Regina Suite at the Piccadilly Hotel, London, W.1. (Cocktail dress.)

Thursday, June 23

Coaches leave from the Ballroom entrance of the Dorchester Hotel for *one* only of the following works visits or group of works visits:—

9.00 a.m. (1) (*a*) Bagshawe & Company, Limited, Dunstable (morning), and (*b*) K. & L. Steelfounders & Engineers, Limited, Letchworth (afternoon). Luncheon and tea by kind invitation of the respective firms.

9.10 a.m. (2) (*a*) Langley Alloys, Limited, Slough, Bucks (morning) and (*b*) High Duty Alloys, Limited, Slough (afternoon). Luncheon and tea by kind invitation of the respective firms.

9.20 a.m. (3) (*a*) (Morning visit to be arranged) and (*b*) A. P. V.-Paramount, Limited, Crawley (afternoon). Luncheon at the Sugar Bowl Club, Burgh Heath, Tadworth; tea by kind invitation of A. P. V.-Paramount, Limited.

9.45 a.m. (4) (*a*) Hoover, Limited, Greenford (morning) and (*b*) British Non-Ferrous Metals Research Association, London (afternoon). Luncheon and tea by kind invitation of the respective firms.

10.00 a.m. (5) (*a*) R. & A. Main, Limited, Edmonton (morning) and (*b*) Belling & Company, Limited, Enfield (afternoon). Luncheon and tea by kind invitation of the respective firms.

10.10 a.m. (6) Morgan Crucible Company, Limited, London (all-day visit). Luncheon and tea by kind invitation of the firm.

10.20 a.m. (7) Lake & Elliot, Limited, Braintree (all-day visit). Luncheon by kind invitation of the company.

10.30 a.m. (8) By river steamer or rail to Ford Motor Company, Limited, Dagenham.

For members of the International Committee and sub-committees there will be meetings occupying the whole day and in the evening (7.30 p.m. for 8.00 p.m.) dinner at the Dorchester Hotel (Orchid Suite) (official representatives—and their ladies—of the constituent associations on the Committee and members of Council—and their ladies—of the Institute of British Foundrymen only); (evening dress); (entrance Deanery Street.)

Evening free for other delegates.

Friday, June 24:

9.00 a.m. Technical film displays prior to the technical sessions.

9.30 a.m. Two simultaneous technical sessions. (G) and (H) papers Nos. 1133, 1134, 1135, 1136, and 1137.

12.45 p.m. for 1.00 p.m. Luncheon in the Ballroom of the Dorchester Hotel; (delegates and ladies); (Ballroom entrance).

2.30 p.m. Closing ceremony of the Congress at the Dorchester Hotel (Ballroom entrance). Presentation of the Award of the International Committee.

6.45 p.m. Reception by Dr. A. B. Everest (president) and Mrs. Everest prior to the Annual Banquet at the Dorchester Hotel; (Ballroom entrance).

7.30 p.m. to 1.00 a.m. Congress Banquet in the Ballroom of the Dorchester Hotel, Park Lane, W.1.; (evening dress). The Banquet will be followed by dancing until 1.00 a.m.

Saturday, June 25:

9.23 a.m. All-day excursion to Blenheim Palace and Oxford with conducted tour of the Palace and Oxford colleges.

Ladies' Programme

(*Where different from that given earlier*)

Sunday, June 19 and Monday, June 20—as given above.

Tuesday, June 21:

9.30 a.m. Ladies are invited to attend the opening of the Congress in the Ballroom of the Dorchester Hotel.

10.45 a.m. Informal reception by Mrs. Everest at the Dorchester Hotel (Ballroom entrance); coffee by invitation.

12.45 p.m. Buffet luncheon.

Coaches leave the Ballroom entrance of the Dorchester Hotel for *one* only of the following visits:—

2.30 p.m. (1) Ackroydon Housing Estate (L.C.C.), Victoria Drive, Wandsworth.

2.35 p.m. (2) City Livery Halls.

2.40 p.m. (3) J. Lyons & Company, Limited, Cadby Hall, London (tea).

2.45 p.m. (4) Derry & Toms, Limited, Kensington High Street, London, W.8 (tea in the Rainbow Restaurant).

Wednesday, June 22

Coaches leave Ballroom entrance of Dorchester Hotel, Park Lane, London, W.1, for *one* only of the following visits:—

9.30 a.m. (5) Hever Castle, Hever, Kent (morning). Luncheon at the Elizabethan Barn, Tunbridge Wells. Lullingstone Castle (silk farm, gardens, Roman villa) (afternoon); tea at Lullingstone Castle.

9.35 a.m. (6) Penshurst Place, Tunbridge, Kent (gardens) (morning). Luncheon at the Elizabethan Barn, Tunbridge Wells. Lullingstone Castle (silk farm, gardens, Roman villa) (afternoon); tea at Lullingstone Castle.

International Foundry Congress

9.40 a.m. (7) Knole House, Sevenoaks, Kent (morning). Luncheon at Bligh's Hotel, Sevenoaks. Drive through Kentish villages, including Chiddingstone (afternoon); tea at the Old Barn, Hildenborough.

Thursday, June 23

9.30 a.m. Coaches leave the Ballroom entrance of the Dorchester Hotel for the following visits:—

(8) Whitefriars Glass Works, Harrow (morning); luncheon at the Tuck Shop, Harrow; and Harrow School and gardens (afternoon); tea at the King's Head, Harrow-on-the-Hill.

or

11.00 a.m. (9) Excursion by river steamer from Westminster Pier (ladies make their own way to Westminster Pier) to Hampton Court; luncheon on the steamer; inspection of state apartments and gardens at Hampton Court during the afternoon. Tea at Nuthalls "Court" Restaurant and return by motor-coach.

Evening free (except for those ladies attending the International Committee dinner).

Friday, June 24

Coaches leave Ballroom entrance of the Dorchester Hotel for *one* only of the following mannequin parades:—(10) Norman Hartnell; (11) Charles Creed; (12) Michael Sherard; (13) Ronald Paterson; (14) Lachasse; (15) Worth.

10.30 a.m. (16) Visit to the leather works of Finnigans, Limited, London, W.1.

Programme of Papers

(Note: During the first half-hour of morning sessions and the last half-hour of afternoon sessions, a series of interesting technical films will be shown.)

Tuesday, June 21

2.30 p.m. to 5.30 p.m. Two simultaneous sessions at the Dorchester Hotel, London, W.1.

SESSION A

No. 1119: "Evaluation of Casting Processes," by Hiram Brown, B.S. (Exchange Paper from the American Foundrymen's Society.)

No. 1120: "Residual Stresses in Castings," by Prof. Albert Portevin and M. Pomey. (Exchange Paper from *l'Association Technique de Fonderie*).

SESSION B

No. 1121: "Influence of Grain-size on the Structure, Pressure-tightness and Tensile Properties of Sand-cast Bronzes and Gunmetals," by A. Cibula, M.A., A.I.M. (Paper from the British Non-Ferrous Metals Research Association.)

No. 1122: "Some Recent Aluminium Casting Developments," by L. Fletcher. (Report of the Light Metal Founders' Association submitted through the Aluminium Development Association.)

Wednesday, June 22

9.00 a.m. to 12.30 p.m. Two simultaneous sessions at the Dorchester Hotel, London, W.1:—

SESSION C

No. 1123: "Metal and Mould Research on Steel Castings." Part I. "Solidification Mechanism," by J. A. Reynolds, B.SC., PH.D., and A. Preece, M.SC., F.I.M. Part II. "Mould- and Core-bonding Agents," by J. M. Middleton, A.MET., A.I.M., and J. White, D.SC., PH.D., F.I.M. (Paper from the British Steel Castings Research Association.)

No. 1124: "Quality Control in a Large Foundry," by Dott. Ing. Romolo Baggio. (Exchange Paper from the *Associazione Italiano di Metallurgia.*)

SESSION D

No. 1125: "Chemical Reactions in the Cupola," by Professor Dr.-Ing. G. A. H. Jungbluth and K. Stockkamp. (Exchange Paper from *Verein Deutscher Giessereifachleute.*)

No. 1126: "Comparative Study of Melting Furnaces in Grey-iron Foundries," by Dr. Ing. B. Marincek. (Exchange Paper from the *Verband Schweizerischer Eisengiessereien.*)

No. 1127: "Results of Metallurgical Studies on the MBC and ADS Cupolas," by Professor A. De Sy and R. Doat, Ing. Civ. Métall. A.I.Lg., Mr. R. Balon and Mr. L. Winandy. (Exchange Paper from *l'Association Technique de Fonderie de Belgique.*)

2.30 p.m. to 5.30 p.m. Two simultaneous sessions at the Dorchester Hotel, London, W.1:—

SESSION E

No. 1128: "Behaviour of Moulding Sands at High Temperatures," by W. B. Parkes and R. G. Godding. (Paper from the British Cast Iron Research Association.)

No. 1129: "Spalling of Green-sand Moulds and its Relation to Casting Defects," by H. Pettersson. (Exchange Paper from *Sveriges Mekanförbund.*)

No. 1130: "Effect of Mould Material on the Solidification Rate of Cast Metals." (Report of Sub-committee T.S. 46 of the Technical Council.)

SESSION F

No. 1131: "Widmanstätten and other Abnormal Graphite Forms in Cast Iron," by E. Bull Simonsen, Mag. Scient, and Floyd Brown, D.SC. (Exchange Paper from the *Norges Stoperitekniske Forening.*)

No. 1132: "Nomogram for Fairly-hot Non-alloyed Iron Cast in Ordinary Dry Sand," by Svend Thegel. (Exchange Paper from the *Stoberiingeniorernes Klub.*)

Friday, June 24

9.00 a.m. to 12.30 p.m. Two simultaneous sessions at the Dorchester Hotel, London, W.1:—

SESSION G

No. 1133: "Moulding in an Indian Foundry," by S. G. Athanikar. (Exchange Paper from the Institute of Indian Foundrymen.)

No. 1134: "A Jobbing Investment Foundry in South Africa," by J. Steele. (Exchange Paper from the South African branch of the Institute.)

No. 1135: "Foundry Industry in Australia," by A. W. Silvester. (Exchange Paper from the Australian branch of the Institute.)

SESSION H

No. 1136: "Ingates." (Report of Sub-committee T.S. 24 of the Technical Council.)

No. 1137: "Gases in Cast Iron," by H. Morrogh. (Report of the Joint Gases Committee of the Institute of British Foundrymen and the British Cast Iron Research Association.)

AT THE annual general meeting of the British Bronze and Brass Ingot Manufacturers' Association yesterday (see page 349 of this issue), Mr. G. T. Whitehouse was re-elected as president and Mr. T. C. James as vice-president. A second vice-president, Mr. F. Baugh, was elected, along with two new members of Council, Mr. W. G. Mochrie and Mr. R. Anderson.

Relationship Between Pouring Temperature, Porosity and Tensile Strength of Sand-cast Bronze

By W. T. Pell-Walpole D.Sc.

After first reviewing the results of three other workers relating porosity and pouring temperature for various bronzes, the Author connects their data with established foundry difficulties with these alloys. A series of experiments is described to give more detailed information on the effect of pouring temperature, using metal of controlled gas content, close control of casting variables and moulds and mould coatings of selected composition as regards their capacity for producing hydrogen. Detailed results and some very enlightening conclusions are quoted.

Pouring temperature has long been recognized as an important factor in the control of quality in sand-cast bronze, and several earlier investigators have published data showing how the density and mechanical properties of a bronze vary with the pouring temperature.[1-3] Two types of curve relating porosity* to pouring temperature can be obtained from results of these investigations (Fig. 1). In one form, porosity increases very gradually at first as the pouring temperature is raised, then, when some critical temperature is passed, rises very rapidly for any further increase in pouring temperature. (Fig. 1 curves A & C). It has generally been deduced that for a given bronze composition there is a safe range (the almost-horizontal branch of the curve) and a dangerous range (the steeply-sloping part of the curve).

In the second type of curve obtained in these earlier investigations there is no inflexion, but a gradual linear increase in porosity with rise of pouring temperature over the whole range investigated, *e.g.*, Bailey's[1] curve (Fig. 1, curve B) for a low-phosphorus bronze (10.6 per cent. tin, 0.15 per cent. phosphorus) is of this linear form, although that for a high-phosphorus bronze (11 per cent. tin, 0.53 per cent. phosphorus) (Fig. 1, curve A) investigated at the same time is of the more complex form with an inflexion marking the upper limit of the safe range, at 1,150 deg. C. Similarly, George[3] found a gradual linear increase in porosity in gunmetal (curve D 88/10 Sn/2 Zn) with increase of pouring temperature up to 1,250 deg. C. Hesse[2] working with a similar alloy (88/9/3) investigated temperatures up to 1,300 deg. C., and his data show an inflexion in the porosity/temperature curve at about 1,250 deg. C. (curve C). It seems likely that when the temperature range investigated is extended to a sufficiently high value, the normal porosity/temperature curve for a sand-cast bronze shows a sudden increase in slope at some critical temperature, the actual value depending on the alloy composition. Below this critical temperature constitutes a safe range, while above it is the "unsafe range" in which porosity in the casting increases very rapidly for only a small increase in pouring temperature. The cause of the change from the safe to the dangerous range has in the past been attributed to the effects of gas in the metal, to the shrinkage porosity associated with long freezing range, or to a combination of these effects.

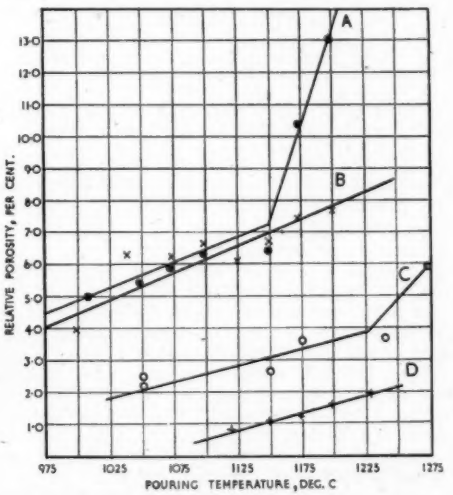

FIG. 1.—*Porosity values for sand-cast bronzes (data obtained from previous work).*

Key: (A) Bailey[1]: for Sn. 11, p. 0.53 per cent. (Δ = 8.15); (B) Bailey[1]: Sn 10.6, P. 0.15 per cent. (Δ = 8.85); (C) Hesse[2]; Sn, 9, Zn. 3 per cent. (Δ 8.87), and (D) George[3]: Sn. 10, Zn. 2 per cent. (Δ 8.87).

Metal/Mould Reaction

It is now well established[4-7] that molten bronzes, other metals and alloys can react with the combined water of moulding or core sands and that the nascent hydrogen evolved is rapidly dissolved by the molten metal. It is known that the extent of porosity produced by this reaction increases rapidly

* Relative porosity values in this figure are calculated against standard density values (Δ) shown in the graph.

Relationship Between Pouring Temperature

at high pouring temperatures and is negligible at pouring temperatures just above the liquidus of the alloy: it is also known that high-phosphorus bronzes react more readily and more violently than do low-phosphorus bronzes or gunmetals. In the light of these considerations, it seems possible that the inflexion in the porosity/pouring temperature curves of sand-cast bronzes might be related to the occurrence of this reaction, since the inflexion is most marked with high-prosphorus bronzes, and occurs in these at a considerably lower temperature than it does in low-phosphorus bronzes or gunmetals.

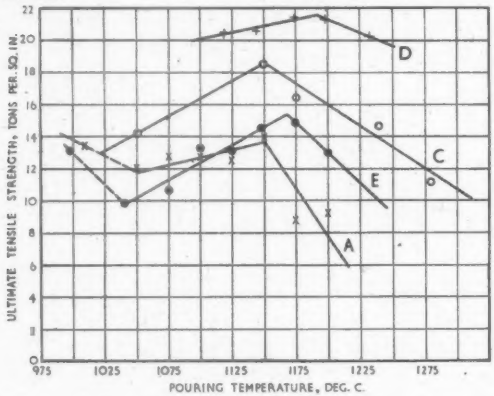

FIG. 2.—*Tensile strength of sand-cast bronzes expressed as a function of pouring temperature (previous work).*

Key: (A), (C) and (D) as in Fig. 1; (E) after Bailey,[1] Sn 10.5 and P. 0.1 per cent.

The corresponding results for tensile strength, taken from the work of the investigators mentioned, are plotted against pouring temperature in Fig. 2. These are difficult to interpret satisfactorily because of their complex forms. The values are probably affected by several contributory factors:—

(1) The amount and structural distribution of the hard ($\alpha + \delta$) or ($\alpha + \delta + Cu_3P$) constituents may affect the values and will vary with casting temperature.

(2) The test-bars used were generally incompletely-fed castings in which the amount of shrinkage porosity may vary with pouring temperature in an irregular manner.

(3) The gas content varies with casting temperature.

Factors (1) and (2) may vary with pouring temperature in such a manner as to affect the strength in the opposite direction to the effects produced by (3). The interaction of these factors probably causes the maximum found in each curve at a pouring temperature varying from 1,150 deg. C. to 1,225 deg. C. Bailey showed that the decrease in strength at low casting temperatures was caused by increasing brittleness produced by the ($\alpha + \delta$) complex: the decrease at high temperatures he attributed to porosity, without specifying the cause of the porosity. Similar effects must be present in the test-bars used by the other workers, but since no data are available on the relative importance of the three factors in the various investigations, it is not possible to analyse these curves in greater detail. The need for further work under closely controlled conditions is clearly indicated.

The present investigation was undertaken to obtain more detailed information on the effect of pouring temperature on the porosity and strength of bronzes cast into various types of sand and other refractory moulds using metal of controlled gas content, with close control of casting variables. In particular, it was hoped to elucidate the part played by the mould reaction with a view to obtaining greater control of this reaction so that the safe range might be extended to cover all casting temperatures likely to be needed in practice.

EXPERIMENTAL METHOD

A high-phosphorus bronze (10 per cent. tin, 0.7 per cent. phosphorus) was chosen as the most suitable composition for studying the effects of mould conditions on the porosity/pouring temperature relationship, since it shows a pronounced variation in porosity with pouring temperature and is known to be very sensitive to the mould reaction.[6] The choice of the test-bar to be used was dictated by the requirements that is should be reasonably well-fed, give consistent results in duplicate castings, and be sensitive to the effects of gas absorption from the mould reaction. Extensive preliminary experiments showed that the top-poured DTD test-bar, as normally used for aluminium alloys, fulfilled these requirements most satisfactorily. Investigators of the British Non-Ferrous Metals Research Association have also found this test-bar the most satisfactory for assessing the effects of gas on porosity in bronze castings.[6] This form of test-bar was therefore adopted and used exclusively throughout the investigation.

The mould materials and mould conditions investigated were as follow:—

(*a*) Bromsgrove green-sand mould with 6½ per cent. moisture, no mould dressing and used immediately after preparation.

(*b*) As (*a*), but the mould baked at 230 deg. C. for two hours before use.

(*c*) As (*a*), but dressed with a mould paint of tar containing 10 per cent. aluminium powder.

(*d*) As (*a*), but dressed with a mould paint of tar with 10 per cent. alumina powder and 10 per cent. plumbago.

(*e*) As (*d*), but mould baked at 230 deg. C. before dressing.

(*f*) Sillimanite bonded with silica (Slix); used as baked, *i.e.*, containing neither combined nor free moisture.

(*g*) As (*f*), but with 1 to 2 per cent. free moisture added.

(*h*) As (*f*), but with 5 per cent. free moisture added.

(*i*) As (*f*), but lined with a wash consisting of the fines (passing 100 B.S.) of Bromsgrove "green" sand; and baked at 200 deg. C.

The pouring temperatures used varied from 1,000 to 1,250 deg. C., and were measured with a Cromel/alumel thermocouple coated with Salamander cement, and baked thoroughly before use.

These experiments were carried out with metal prepared from electrolytic copper, Chempar tin and phosphor-copper, under an oxidizing flux (1 part CuO, 1 part fused borax, 1 part sea sand), so that the results show the effects of mould conditions and of pouring temperature on the porosity of bars cast from metal initially as free from gas as it could be obtained under industrial melting conditions. In order to assess the effects when gas is present in the metal before pouring begins, further series of bars were cast in moulds (*a*), (*d*) and (*f*) from metal melted under charcoal and not degassed.

Density Checks

The head of each test-bar was removed and the surface was ground to remove any adhering sand and rough exudations. The apparent density at 20 deg. C. was then determined by the Archimedes method. Check chemical analyses on many of the bars showed that the phosphorus content was not varying sufficiently to have an appreciable effect on density. Hence the density measurements may be used as a direct guide to the amount of porosity present.[9] The porosity was calculated on the assumption that a density of 8.75 gm. per c.c. is the highest practicable density for a casting of this alloy. This is the highest figure regularly obtained by the Author for slowly-poured degassed chill castings in this alloy. In the present work it was found that duplicate castings prepared in refractory moulds under optimum conditions (degassed metal cast into the dry, sillimanite mould) may vary in porosity by $\pm$ 0.5 per cent. With moist sillimanite moulds or with green-sand moulds, considerably greater scatter of values up to $\pm$ 1 per cent. porosity was encountered. Similarly, with regard to control of pouring temperature, it is considered that the accuracy is not greater than $\pm$10 to 15 deg. C. In view of this apparently unavoidable scatter in the values of both variables, the results given in the graphs are mean values from 2, 3, 4 or 8 bars. Four test-bars were used to obtain the most important graphs viz.: those for degassed metal, on (*a*) the dry, sillimanite mould, (*b*) the non-coated "green" Bromsgrove sand mould and (*c*) the sillimanite mould lined with Bromsgrove sand fines. With (*b*) and (*c*) eight bars were used for those points on the graph immediately adjacent to the inflexion. With the other mould conditions, scatter was less than with the green-Bromsgrove sand, and in general two bars were used to determine each plotted value.

RESULTS

I—Porosity Curves for the Sillimanite Moulds

Graphs showing the relationship between porosity and pouring temperature for bars cast in the sillimanite moulds are shown in Fig. 3. These curves are all linear, irrespective of whether gassy or gas-free metal was used and irrespective of whether the mould was dry or moist. There are, however, marked differences in the slope of the curves according to the individual conditions of the metal and mould. When degassed metal was used with a dry mould the slope was relatively slight (curve A), (3.0 per cent. porosity for a 200 deg. C. rise in pouring temperature) approaching the type of relationship obtained with a chill mould. With degassed metal cast into a mould containing 1 to 2 per cent. free moisture, the slope is considerably steeper (curve B); while with the combination of gassy metal cast into a dry mould or of degassed metal into a mould saturated with moisture (5 per cent.) the slope is very steep (curves C and D).

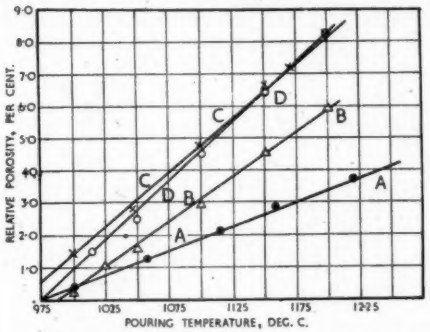

FIG. 3.—*Porosity curves for test-bars made in sillimanite moulds (free from combined moisture).*

Key: (A) Dry mould, degassed metal; (B) mould with 1 to 2 per cent. water added, degassed metal; (C) dry mould, gassy metal, and (D) mould with 5 per cent. water added, degassed metal.

Curve A may be considered as representing the effects of pouring temperature on shrinkage porosity only, since the metal was initially free from gas and there was no gas-generator present during casting or solidification. At low pouring temperatures this mould gave bars with densities equal to those obtained with a chill-cast degassed metal, cast so as to be virtually free from shrinkage porosity. Increase in pouring temperature caused a more rapid increase in the extent of shrinkage porosity than with a chill mould. This is because the much lower thermal diffusivity of the sillimanite causes the pasty zone to extend more rapidly as the pouring temperature is raised.

The remaining curves for the sillimanite mould show the effect of pouring temperature on the porosity of metal which contains gas. In curves B and C, the gas is absorbed from reaction with the free moisture present in the mould; in curve D, the gas was present before the commencement of casting. Curves C and D have similar slopes, although the source of the gas is different in the two cases.

II—Porosity Curves for Sand Moulds

When degassed metal of the same composition is cast into sand moulds which have a similar chilling

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capacity to the sillimanite moulds, the porosity/pouring temperature relationship might be expected to conform either to the shrinkage form (Fig. 3 (A)) or to the gas form (Fig. 3 (C) (D)) discussed earlier. In fact the experimental curves (Figs. 4 and 5) for the sand moulds are not simple straight lines but appear to represent a combination of gas shrinkage effects, showing a break and a sharp change in slope similar to that noted in the review of earlier work (Fig. 1). The temperature at which the break occurs is not affected by the initial gas content of the metal but varies according to the mould condition. With uncoated "green" Bromsgrove-sand moulds, the break occurs at about 1,050 deg. C. Baking the moulds before use (Fig. 5 (A)) or coating them with the aluminium/tar dressing (Fig. 4 (C)) raises the temperature of the break to 1,100 deg. C. while coating with the alumina/tar dressing raises it to 1,150 deg. C. (Figs. 4 (D) and (E) and Fig. 5 (C)). When this dressing is used, baking the mould has no effect on the temperature of the break.

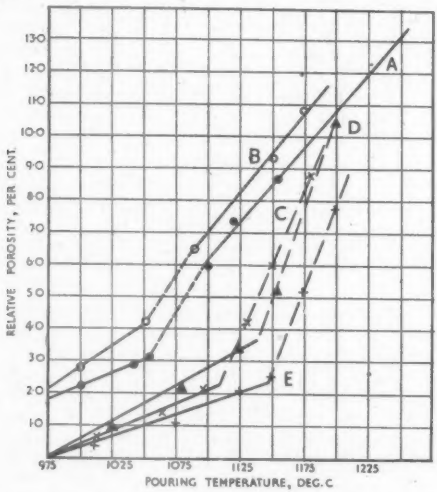

FIG. 4.—*Porosity curves for test-bars cast into moulds of "green" Bromsgrove sand* (6½ *per cent. moisture*), i.e., *containing both free and combined moisture.*

Key: (A) uncoated mould, degassed metal; (B) uncoated mould, gassy metal; (C) mould coated with Al/tar, degassed metal; (D) mould coated with Al_2O_3/tar, gassy metal, and (E) mould coated with Al_2O_3/tar, degassed metal.

Below the temperature of the break, the slopes of the various porosity/pouring-temperature curves have a close affinity with the various curves for the sillimanite moulds. Thus those for degassed metal cast into coated moulds have slopes which do not differ significantly from the pure shrinkage form which is obtained with degassed metal cast into the dry sillimanite mould. It appears that with casting temperatures not exceeding 1,100 deg. C. for the aluminium/tar dressing or 1,150 deg. C. for the alumina/tar dressing the sand-castings are free from gas porosity.

The lower portion of curves for the uncoated moulds, "green" or baked, have a somewhat steeper slope indicating a slight gas content. These curves are also displaced upwards on the porosity axis, so that some porosity is present even with the lowest possible casting temperatures. Both of these effects are probably caused by the *free* moisture of the sand mould. When the molten metal is poured, the free moisture evaporates, so that the metal is poured in an atmosphere having an appreciable water-vapour content. This is well known as a common source of hydrogen pick-up in molten alloys.

The lower portion of the curve for the uncoated sand mould with gassy metal has a slope similar to that for gassy metal cast into the dry, sillimanite mould, but again the curve is displaced upwards on the porosity axis, as for the other uncoated moulds.

When gassy metal is cast into a coated green-sand mould, the lower portion of the curve is less steep than for the uncoated mould and the curve

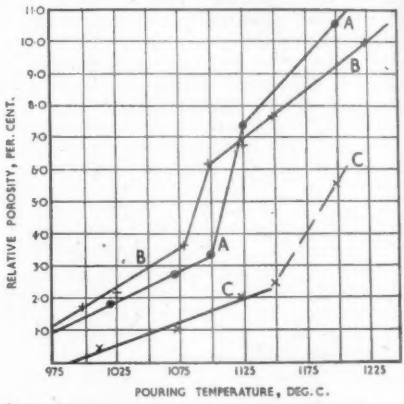

FIG. 5.—*Porosity curves for test-bars cast into "green" Bromsgrove sand moulds* (6½ *per cent. moisture*), i.e., *containing both free and combined moisture.*

Key: (A) uncoated Bromsgrove sand, baked at 200 deg. C.; (B) sillimanite mould lined with fine Bromsgrove sand baked at 100 deg. C.; and (C) Bromsgrove sand mould baked at 200 deg. C. and coated with Al_2O_3/tar mixture.

commences from the origin, *i.e.*, the gas content at low pouring temperatures is much reduced by the action of the mould coating. Thus, the dressing not only protects the metal from the action of the steam generated from the free moisture of the mould but appears to exert a positive degassing action. This is probably effected by the scavenging action of a non-soluble gas bubbling through the gassy metal, for the tar of the dressing emits a considerable volume of carbonaceous gases during casting.

Immediately above the temperature of the break in the curves for the sand moulds, the slope be-

comes very steep for all the various conditions investigated. At somewhat higher temperatures, 1,075 to 1,100 deg. C. for the uncoated moulds, there is a second inflection, beyond which the slope of the curves is similar to that of the typical "gas" curves of Fig. 3. (With coated moulds it appears that this final stage would only be obtained with pouring temperatures above 1,200 deg. C.) The gas responsible for the sudden increase in porosity which occurs when the pouring temperature exceeds that of the lower break, must be derived from a source which only becomes operative when some critical temperatures are exceeded. The most likely source is the well-known mould reaction between molten metal and the combined moisture in the sand.

The critical pouring temperature which must be exceeded for this reaction to occur probably corresponds with the foundryman's conception of an upper limit of the safe range of pouring temperature. It varies with the mould condition, and with mould coating. The weakly-bonded water of "green" sands appears to react at a lower temperature than the strongly-bonded residual moisture of baked sands, but the action of mould dressings on reaction temperature appears to be one of simple mechanical protection rather than of chemical action. These dressings probably form a strong jacket on the mould which protects the metal from the steam atmosphere generated by the free moisture of the mould, and prevents direct contact between the metal and the hydrated bond of sand. Above a certain pouring temperature (1,100 deg. C. for the aluminium coating, 1,150 deg. C. for the alumina coating) this protective layer breaks down under the action of the molten metal and permits the reaction to occur. Independent tests have shown that the tar alone does not give the same degree of protection, and it seems that with both dressings aluminium oxide is the protective agent. In the dressing containing aluminium powder, the oxide is present only as a very thin layer on each metal particle, and the thinner protective layer produced on the sand breaks down at a lower temperature than that which is withstood by the thicker layer of the dressing containing Al_2O_3, as such.

In order to confirm that the break in the curves for the sand moulds is attributable to the chemical constitution of the bonded sand rather than to any physical property of the sand mould, a series of castings was made in a sillimanite mould which was given a surface coating (40 gm.) of a loam made from the fines (passing 100 B.S.) from Bromsgrove sand. The moulds were baked before use to drive off the excess free moisture present in the loam. The porosity/pouring temperature for this series of castings (Fig. 5 (B)) is similar to those obtained with the uncoated Bromsgrove sand moulds, showing a break at 1,075 deg. C., with the slopes above and below the break very similar to the corresponding portions of curves for 4 (A) and (B) and 5 (A). The amount of loam used was insufficient to have a significant effect on the thermal properties of the sillimanite mould, and the inflection in the porosity curve must be caused by the action of the combined moisture of the loam.

III—Tensile Strength

Curves showing the effect of pouring temperature on tensile strength of the ingots cast under the various experimental conditions are given in Figs. 6 to 8. These curves do not exhibit the simple linear characteristics found in the corresponding porosity curves, so that direct comparison of the two groups is difficult. The cause of the differences in form becomes apparent when the values of tensile strength for all specimens are plotted against the corresponding porosity values as in Fig. 9. The resulting graph is curved and convex downwards, and there is considerable scatter caused by the varying effects of the different types of porosity present.

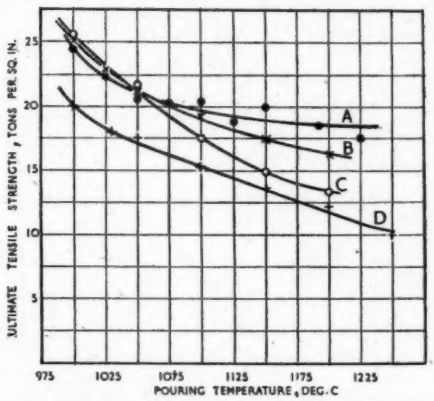

FIG. 6.—*Strength of bars cast in sillimanite moulds, i.e., free from combined moisture.*

Key: (A) Dry mould, degassed metal; (B) mould with 1 to 2 per cent. water, degassed metal; (C) mould with 5 per cent. water, degassed metal, and (D) dry mould, gassy metal.

The curvelinear relationship between strength and porosity is readily understood when the different dimensions involved in these properties are considered: the tensile strength is calculated with reference to the *cross-sectional area*, whereas porosity is calculated as a ratio of pore volume to total *volume* of the specimen. A simpler relationship may be expected, therefore, if the area of pores in a cross-section is considered instead of the volume of the pores. Pore area cannot be measured directly, but if it be assumed that the pores approximate in shape to spherical cavities, then the pore area in the cross section should be proportional to (porosity, per cent.)$^{\frac{2}{3}}$. Employing this assumption, the values of pore area have been calculated from the porosity values and are plotted against the corresponding values of tensile strength in Fig. 10. A linear correlation is obtained, showing that loss of tensile strength is directly proportional to the pore area in the cross-section, and is therefore proportional to (porosity)$^{\frac{2}{3}}$. This

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relationship permits a more satisfactory comparison to be made between the curves for tensile strength and those for porosity.

The graphs in sections (I) and (II) show that the relation between porosity and superheat (superheat = pouring temperature −975 deg.) is of the form:

P (porosity per cent.) = K × T^s (superheat)

over any temperature range in which the factors producing porosity remain unchanged. The loss of tensile strength caused by porosity has been shown above to be proportional to pore area $(P)^{\frac{1}{3}}$, hence the curves relating tensile strength to superheat should be of the form:

$$\text{u.t.s.} = A - KT^{\frac{1}{3}}$$

(where A = u.t.s. of a perfectly sound specimen). Thus each linear portion of a graph of porosity/pouring-temperature will be represented on the corresponding graph of u.t.s./pouring-temperature by a curve the slope of which becomes progressively less steep as the pouring temperature increases. This is, in fact, the general form of the experimental curves of u.t.s./pouring-temperature as shown in Figs. 6 to 8.

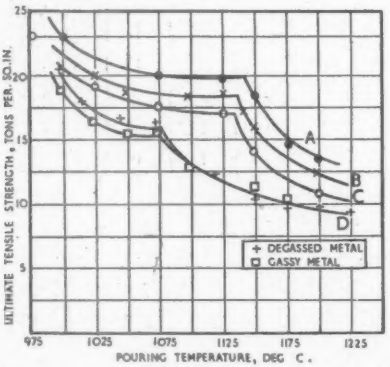

FIG. 7.—*Strength of bars cast in "green" Bromsgrove sand (6½ per cent. moisture), i.e., containing both free and combined water.*

Key: (A) Mould coated with Al_2O_3/tar, degassed metal; (B) mould coated with Al/tar, degassed metal; (C) mould coated with Al_2O_3/tar, gassy metal and (D) uncoated moulds, degassed and gassy metal.

It is probably because of the characteristics of this form of curve that the onset of the mould reaction is not shown so clearly by certain of the u.t.s./pouring-temperature curves, as by the corresponding porosity/pouring-temperature curve. This occurs when the reaction commences at a low pouring temperature, and when the change in slope in the porosity curve is relatively slight, *e.g.*, as in the curves for the uncoated sand moulds and that for the sillimanite mould lined with fine Bromsgrove sand. On the other hand, when the mould reaction, as indicated by the break in the porosity curve, occurs at a relatively high temperature, *e.g.*, with the coated sand moulds, then the u.t.s. curves also show a pronounced break at the same temperature.

A feature of interest in the u.t.s. curves for the sillimanite moulds, is that higher values are obtained for bars containing a little gas absorbed during casting at low pouring temperatures than for gas-free metal cast at the same temperature. This is probably caused by a uniform distribution of porosity across the section in the low-gas-content test-bar, and the concentration of residual shrinkage porosity along the axis in the gas-free bars. Machining the bars to a standard test-piece 0.564 in. dia., causes a relative increase in the amount of porosity in the gas-free bars, since the very sound outer layers are machined away. In the low-gas-content bars, there would be no relative change in porosity, and the latter in the machined condition would probably be sounder and therefore stronger than the machined gas-free bars. When gas is initially present in the metal it is concentrated along the axis, and these bars are inferior to gas-free bars.

The most important practical feature of tensile-test results, is that consistently high values of u.t.s. can be obtained with coated sand moulds over a wide range of pouring temperature, *e.g.*, with either

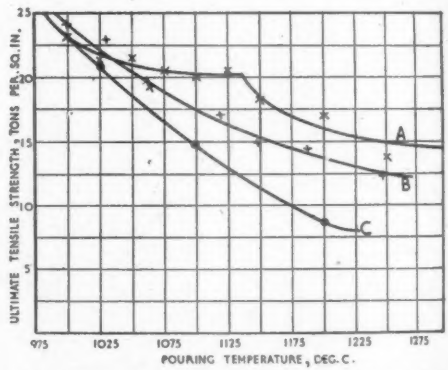

FIG. 8.—*Strength of bars from degassed metal cast into baked moulds, i.e., no free moisture present.*

Key: (A) Bromsgrove sand mould coated with Al_2O_3/tar; (B) sillimanite mould coated with fine Bromsgrove sand, and (C) mould of Bromsgrove sand, uncoated.

"green" or baked Bromsgrove sand coated with Al_2O_3/tar, values of 20 tons per sq. in. or higher are obtained with any pouring temperature up to 1,150 deg. C. These values should be compared with the specification requirement of 12 tons per sq. in. for this alloy.

IV—Elongation Values

The values of elongation corresponding to the plotted values of tensile strength are recorded in

TABLE I.—*Mean Values of Elongation (Per Cent. on 2 in.) for Phosphor-bronze Test-bars Cast in Various Types of Moulds.*

Metal	Mould.	Pouring temperature, deg. C. (to ± 12 deg.).									
CONDITION.	CONDITIONS.	1,000.	1,025.	1,050.	1,075.	1,100.	1,125.	1,150.	1,175.	1,200.	1,225.
Degassed ..	Dry, sillimanite	39	21	17	18	17	13	17	17	—	15
Degassed ..	Sillimanite, + 1-2 per cent. H_2O	20	20	17	20	20	—	18	13	5	—
Degassed ..	Sillimanite, + 5 per cent. H_2O..	33	29	16	—	13	6	7	—	8	—
Gassy ..	Dry, sillimanite	7	—	11	8	12	8	8	6	7	6
Degassed ..	Bromsgrove "green," uncoated	18	18	10	—	7	5	5	3	—	—
Degassed ..	Bromsgrove "green," coated Al/tar	19	14	10	14	12	8	5	—	—	—
Degassed ..	Bromsgrove "green," coated Al_2O_3/tar	27	22	—	—	21	16	17	5	7	—
Gassy ..	Bromsgrove "green," uncoated	10	6	7	6	5	—	3	2	—	—
Gassy ..	Bromsgrove "green." coated Al_2O_3/tar	—	19	—	—	—	10	5	5	1	—
Degassed ..	Bromsgrove, baked, uncoated ..	—	23	—	—	13	7	—	—	1	—
Degassed ..	Bromsgrove, baked, coated Al_2O_3/tar	28	27	24	24	18	20	19	—	7	—
Degassed ..	Sillimanite, coated with fine Bromsgrove sand and baked..	25	31	17	17	12	15	10	8	9	6

Table I. The values are more erratic than the strength values, but in general they decrease rapidly with increase in pouring temperature for each series, and are very low (5 to 10 per cent.) for bars gassed by the mould reaction. The highest values, recorded for degassed metal cast into dry sillimanite or coated sand moulds at low pouring temperatures, vary from 25 to 35 per cent. on 2 in. In general, if the tensile strength is 20 tons per sq. in. or over, the elongation is not less than 15 per cent.

SUMMARY AND CONCLUSIONS

(1) The form of the curve relating porosity to pouring temperature for a standardized sand-cast phospor-bronze test-bar depends on four factors:—(*a*) Solidification shrinkage; (*b*) the initial gas content of the melt; (*c*) the action of the free moisture content of the mould; (*d*) the action of the combined moisture present in the mould.

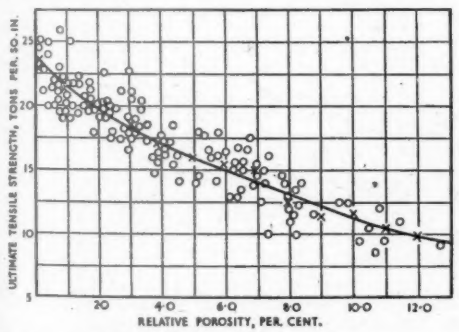

FIG. 9.—*Relationship between porosity and tensile strength.*

(*a*) Solidification shrinkage alone (degassed metal cast into a dehydrated sillimanite mould) gives a linear relationship in which porosity increases gradually with increase of pouring temperature.

(*b*) When gas is initially present in the melt, but the mould is free from moisture in any form (gassy metal cast into dehydrated sillimanite mould) a steeper linear relationship exists, porosity increasing rapidly as the pouring temperature is increased.

(*c*) When the metal is initially free from gas and the mould contains free but not combined moisture (degassed metal cast into a sillimanite mould to which water has been added) the relationship between porosity and pouring temperature is very similar to that obtained with gassy metal and a dehydrated mould.

(*d*) When combined moisture is present in the mould, irrespective of initial gas content of the metal or of the free water content of the mould, a complex relationship exists between porosity and pouring temperature, *e.g.*, for gassy or degassed metal cast into "green" or baked-sand moulds, or for bars cast into a sillimanite mould coated with red sand. The curves for these conditions comprise, as the pouring temperature increases:—(i) a linear branch; (ii) a steeply-sloping short branch of a variable form, and (iii) a second steeper linear branch. The slope and position of the lower linear branch of the curve depend on the initial gas content of the metal and on the free moisture content of the mould.

The slope of the upper linear branch is similar for all casting conditions: it is very steep, indicating a high gas content in the solidified metal. This gas is derived from reaction during casting between the molten metal and the combined moisture of the mould. If the pouring temperature be sufficiently high, the metal appears to become saturated with gas, producing a consisent slope in the porosity curve, irrespective of the initial gas-content of the metal and of the free moisture-content of the mould.

The mould reaction occurs only above a critical pouring temperature and complete saturation of the metal with gas from this source does not occur until the pouring temperature is considerably higher than the critical value. This middle range of temperature is represented in the porosity graphs by the intermediate portion. The porosity produced in the range of pouring temperature is variable and difficult to control. It probably depends on the rate of generation and diffusion of the hydrogen in relation to the rate of cooling of the metal.

The lower linear portion of the porosity curve may be regarded as approximating to the foundryman's "safe casting range," the intermediate and

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upper linear portions, indicating "the danger zone." The limit of the safe range, *i.e.*, the lowest temperature at which the mould reaction occurs, is independent of the initial gas content of the metal, but varies with the mould condition and mould coating. (It would probably vary also with alloy composition, and with the character of the bonding clay present in the sand, but these factors have not yet been investigated.)

(2) A mould coating consisting of a suspension of Al_2O_3 and plumbago in a tar-oil base can be applied to "green" or baked sand moulds to reduce porosity in phosphor-bronze castings. It has a three-fold action:—(*a*) It evolves a stream of carbonaceous gases during casting, which bubble through the molten metal, exerting a scavenging action and thus remove some of the hydrogen initially present in the melt; (*b*) it protects the metal from the harmful effects of steam generated from the free moisture of the mould, so that with low pouring temperatures it gives castings as sound as those obtainable from chill moulds; and (*c*) it extends the safe range of casting temperatures for high-phosphorus bronze from approximately 1,050 to approximately 1,150 deg. C., by preventing the molten metal from reacting with the combined moisture of the sand mould. This protective action breaks down if the pouring temperature exceeds 1,150 deg. C.; but this is not a serious limitation, since in practice so fluid a bronze rarely requires so high a casting temperature. This dressing therefore virtually renders the bronze immune to the mould reaction for sections sizes of 1 to 2 in. This should prove useful in all castings where minimum gas content is desirable.

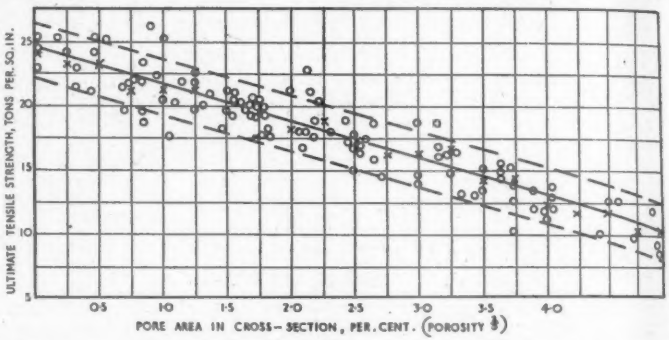

FIG. 10.—*Relationship between pore area in the cross-section, and tensile strength.*

(3) The tensile strength of sand-cast test-bars is shown to vary linearly with the pore-area per cent. in the cross-section, not with the porosity per cent. This complicates the form of the curves relating tensile strength to pouring temperature, and tends to obscure the break between the "safe" and "danger" zones when this break occurs at a low pouring temperature, *e.g.*, with uncoated sand moulds. With coated moulds in which the gas reaction responsible for the break does not occur until higher pouring temperatures are used, then its effect on the strength curves is clearly shown.

(4) In agreement with the conclusions on the control of soundness in these castings, it is shown that tensile strength can be maintained at 20 tons per sq. in. with 15 to 25 per cent. elongation for pouring temperatures up to 1,150 deg. C., by coating Bromsgrove sand moulds (either "green" or baked) with a dressing containing 10 per cent. Al_2O_3/10 per cent. plumbago in a tar-oil carrier.

Acknowledgments

This research was carried out under the terms of an ICI Fellowship in the laboratories of the Metallurgy Department, Birmingham University. The Author is indebted to the late Professor D. Hanson and to Professor A. J. Murphy for laboratory and other facilities, to D. F. Tranter and A. C. Atwood for help with experimental work, and to the Tin Research Institute for financial support. He also wishes to acknowledge useful discussion on the work with Dr. V. Kondic, lecturer in foundry metallurgy at the University, and with Mr. J. Ireland, director of the Tin Research Institute.

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More Canadian Steel

It is reported from Montreal that Canada's steel-ingot output in February reached its highest monthly total for a year. Last month's production amounted to 314,814 tons, compared with 310,853 tons in January and 588,765 tons in February, 1954.

Output in the first two months of this year was 625.667 tons, against 549,252 tons in January-February, 1954.

Russian Iron and Steel Production

According to a report in "L'Ossature Metallique," No. 6, 1954, a Belgo-Luxemburg publication, the fifth Russian five-year plan, which ends this year, envisaged a production of 41,100,000 metric tons of steel ingots for 1954. In 1952, the figure was 35,000,000. It is stated that several blast furnaces at Magnitogorsk and Kuzuchsk have been working under high-top pressure.

Bronze and Brass Ingot Manufacturers' Association

Mr. G. T. Whitehouse, the president, in the course of his report to the annual meeting of the British Bronze and Brass Ingot Manufacturers' Association, held in Birmingham yesterday, said that with the admission of MacKinlay (Glasgow), Limited, the membership of the Association has risen to 28.

Prices and Co-operation with the ABBF

During the year wide fluctuations of copper prices had been experienced; these were largely due to the influence of supply and demand related to economic factors and political events over which the Association had no control. Industrial strikes in copper mining were the major cause, and a reduction in the supply, whereas he considered an expansion of output to meet growing demands was long overdue. In February, when copper reached a record high price, the Association of Bronze and Brass Founders approached the Ingot Manufacturers' Association for advice, and their president and council members were present at the last Council meeting of the Ingot Manufacturers, when it was pointed out that fluctuations could be greatly ironed out by metal consumers covering forward for their requirements, and playing fair when prices fell and in this the Bronze and Brass Founders could play a part. After long discussions, it was agreed to join in a deputation to the responsible Government officials. The result of the meeting had shown that the Government was unwilling to act, and could not do so without reintroducing all the paraphernalia of controls, which were unacceptable to the industry. Economic laws were bringing their own solution. In the meantime the Association was happy to have exchanged views with the ABBF members and it was hoped to have further meetings with them from time to time.

Weekly Price List

A number of the members of the Council has continued to submit actual average prices obtained, which had enabled the Association to issue average prices to the Press week by week. The arrangement had not been without criticism, but it was a means of arriving at unbiased information for the Press, and probably helped to limit the range of prices quoted from time to time.

Association Manual

The Association's Manual* was now being distributed. Copies had been sent to some 1,250 firms reported to the secretaries by members as being customers. Members had so far ordered 1,171 copies to distribute themselves. The Manual contained most useful information covering various branches of industry, and he believed it would be very popular. The secretaries had received very encouraging letters from those who have had the opportunity of reading it, and it had already had a good Press report.

The object of the Manual was to make non-ferrous metal consumers ingot conscious, so that they would use, as a matter of course, more and more ingots to specification. In these days of increasing mass production the manufacturer required reliable raw material of consistent quality, and the Manual was intended to show that in using specification metal bought from a member of the Association, he obtained such raw material on which he could plan production with confidence.

Export Quotas

The Association had had several interviews with the Ministry with regard to export quotas and there was good reason to believe that when the current shortage of copper had passed, important steps towards freeing the export trade could be taken. In the meantime, due to these representations, the proportion of brass in the quota was raised to 40 per cent., and now more recently to 50 per cent. Steps were taken to urge that precautions be taken so that specification metal could not be imported duty free under the category heading of scrap melted down.

Social Function

The annual social function of the Association was held last November, and there was no doubt that it had been a great success socially; unfortunately, however, a slight financial loss was incurred. Arrangements had been made for this year, as it was of course necessary to make bookings a considerable time in advance. Members should now consider whether this function benefited trade, and, if so, they should make every endeavour to support it, otherwise they should consider whether it should be discontinued in 1956.

Technical Committee

The Association's technical committee had been considerably strengthened during the year, enabling it to spread work and so make better progress. There would be a separate report by the chairman of this committee. He mentioned that a particularly pleasing feature was the friendly contact that the committee maintained with the founders' organization.

Census of Production

The Association had protested that as far as it was concerned the Census of Production served no useful purpose, and of course in this it was not alone. The Government had decided that the information obtained from the Census was essential to them and so they would continue it; however, the simplification of the questions should make the completion of the return an easier matter, for which everybody would be thankful; it was apparently in this direction that progress was to be sought. It was of course realized that small firms of 24 employees or fewer were exempt.

Vice-presidents

The constitution of the Association provided for one vice-president. He thought it would be helpful to the president if provision was made for an additional vice-president, and that this would ensure greater continuity in the work of the Association. He was therefore proposing a suitable modification to the constitution.

The past year had shown an improvement in trade, and although there was still room for improvement in the prices of ingots, they were a little more realistic than at one time. The prospects of trade for the future were very good. The aircraft and the motor industry with their large orders, the re-equipment of the railways and international trade improvements, etc., all augured well, and it was up to members to keep their plant and equipment up to date.

In conclusion, he thanked all the members of the Council, especially those who had accompanied him on the visits to the Ministry. He paid tribute to Mr. Chalmers for the long service he had given to the Council and expressed his regret that he was unable to continue; he thanked Mr. Fred Baugh for his work on the Manual (which was yet another achievement of the Association), and the Technical Committee, for the time given to this important work under the able chairmanship of Mr. W. G. Mochrie. Also, he expressed appreciation to Mr. Sidney Platt for his excellent organization of the social function, and also to the hard-worked secretaries, who were almost indispensable. He assured members that the president's task would always be a most difficult one but for the ready help always available from the secretaries.

* Reviewed in last week's JOURNAL.

IBF Congress Fund

Second List

The Council of the Institute of British Foundrymen acknowledges with very much appreciation the further subscriptions received up to March 7 for the special fund which is being raised in connection with the International Foundry Congress to be held in London in June. It should be noted that Mr. N. P. Newman, J.P., of Newman Hender & Company, Limited, Woodchester, Stroud, Glos, is honorary treasurer of the Congress Fund, and he will be very pleased to receive additional subscriptions.

	£	s.	d.
Allied Ironfounders, Limited	105	0	0
Birmid Industries, Limited	105	0	0
Qualcast, Limited	100	0	0
Davy & United Engineering Company, Limited	100	0	0
Louis Cassier Company, Limited	100	0	0
Hadfields, Limited	100	0	0
Newton Chambers & Company, Limited ...	100	0	0
Thos. W. Ward, Limited	100	0	0
Austin Motor Company, Limited	100	0	0
Brightside Foundry & Engineering Company, Limited	100	0	0
International Meehanite Metal Company, Limited	75	0	0
Babcock & Wilcox, Limited	50	0	0
Federated Foundries, Limited	50	0	0
Edgar Allen & Company, Limited	50	0	0
Phosphor Bronze Company, Limited ...	50	0	0
Ferranti, Limited	50	0	0
Hopkinsons, Limited	50	0	0
Radiation, Limited	50	0	0
G. & J. Weir, Limited	50	0	0
Shotton Brothers, Limited	31	10	0
J. & E. Hall, Limited	30	0	0
Ransomes, Sims & Jeffries, Limited ...	30	0	0
George Richards & Company, Limited ...	26	5	0
Fordath Engineering Company, Limited ...	25	0	0
C. A. Parsons & Company, Limited ...	25	0	0
Baker Perkins, Limited	25	0	0
Textile Machinery Makers, Limited ...	25	0	0
Wm. Jessop & Sons, Limited	25	0	0
Worthington-Simpson, Limited	25	0	0
Foundry Equipment, Limited	25	0	0
North Eastern Marine Engineering Company (1938), Limited	25	0	0
Peter Brotherhood, Limited	20	0	0
Glenfield & Kennedy, Limited	20	0	0
Mavor & Coulson, Limited	20	0	0
Thomas De La Rue & Company, Limited ...	20	0	0
Alfred Ellison, Limited	15	15	0
Ransomes & Rapier, Limited	15	0	0
Dilworth & Carr, Limited	10	10	0
G. & N. Thomas, Limited	10	10	0
Seagers, Limited	10	10	0
W. C. Holmes, Limited	10	10	0
Carron Industries, Limited	10	10	0
Northampton Foundry Company, Limited	10	10	0
Fine Castings, Limited	10	10	0
Geo. Oxley & Sons, Limited	10	10	0
Westinghouse Brake & Signal Company, Limited	10	10	0
Booth & Brookes, Limited	10	10	0
North British Steel Foundry, Limited ...	10	10	0
Chamberlin & Hill, Limited	10	10	0
Swinney Brothers, Limited	10	10	0
Rapid Magnetic Machines, Limited ...	10	10	0
T. H. & J. Daniels, Limited	10	10	0
Mitchell, Russell & Company, Limited ...	10	10	0
Eric Salinger, Esq.	10	10	0
Steel Company of Scotland, Limited ...	10	10	0
Bonnington Castings, Limited	10	10	0
David Caird, Limited	10	0	0
Ryder Brothers, Limited	10	0	0
A. Reyrolle & Company, Limited	10	0	0
E. N. & F. Turner, Limited	10	0	0
John I. Thorneycroft & Company, Limited	10	0	0
Dewrance & Company, Limited	10	0	0
Belliss & Morcom, Limited	5	5	0
British Jeffrey-Diamond, Limited	5	5	0
H. Broadbent & Son, Limited	5	5	0
R. W. Collin & Company, Limited ...	5	5	0
Crown Castings, Limited	5	5	0
Grayson, Rollo & Clover Docks, Limited	5	5	0
C. & J. Hampton, Limited	5	5	0
Holman Brothers, Limited	5	5	0
Kingsworthy Foundry Company, Limited ...	5	5	0
Knete Castings, Limited	5	5	0
John Lynn & Company, Limited	5	5	0
Manganese Bronze & Brass Company, Limited	5	5	0
Mason & Burns, Limited	5	5	0
Mather & Smith, Limited	5	5	0
McKechnie Brothers, Limited	5	5	0
Ian Ross (Castings), Limited	5	5	0
St. Pancras Engineering Works, Limited ...	5	5	0
James Smethurst & Son, Limited	5	5	0
Turner Tanning Machinery Company, Limited	5	5	0
W. Woodcock, Sons & Company, Limited	5	5	0
Walter Wilder & Sons, Limited	5	5	0
Armstrong Whitworth (Metal Industries), Limited	5	0	0
Brecknell, Dolman & Rogers, Limited ...	5	0	0
Foundry & Engineering Company (West Bromwich), Limited	5	0	0
Laycock Engineering, Limited	5	0	0
Stothert & Pitt, Limited	5	0	0
International Harvester Company of Great Britain, Limited	5	0	0
Hopyard Foundries, Limited	3	3	0
F. Parramore & Sons, Limited	3	3	0
Taylors Foundry, Limited	3	3	0
Thomas Ashworth & Company, Limited ...	3	0	0
Brockmoor Foundry Company, Limited ...	2	2	0
Gordon Foster, Esq.	2	2	0
Groves & Gutteridge, Limited	2	2	0
R. Hunt & Company, Limited	2	2	0
Shaw Glasgow, Limited	2	2	0
Trianco, Limited	2	2	0
Thos. White & Sons, Limited	2	2	0
Glover & Wood, Limited	1	1	0
Storey Foundry Company, Limited ...	1	1	0
Crown Foundry Company, Limited ...	1	1	0
Grand Total to date	£3,801	1	0

[Attention is called to an error which occurred in the first list of subscriptions published in the January 27 issue of the JOURNAL in which a subscription of £75 0s. 0d. was credited to S. H. Russell & Company, Limited. This subscription was contributed by S. Russell & Sons, Limited, of Leicester.]

THE DISCOVERY of a long half-life radioactive isotope of aluminium has been announced from Carnegie Institute of Technology. Hitherto, the known radioactive isotopes of aluminium had maximum half-lives of only a few minutes. The isotope now discovered is said to have a half-life of about a million years, and is known as aluminium 26.

Nodular Cast Iron*

Present Position and Future Prospects as an Engineering Material, with Special Reference to Suitability for Crankshafts

London Discussion of the Paper by S. B. Bailey, M.Sc. (Eng.), M.I.Mech.E.†

[SLIGHTLY ABRIDGED]

(Continued from page 324)

Continuing his replies to the discussion, the Author first deals with ductility and impact resistance—presenting further data, and relating his findings to the shape of stress/strain curves. Discussing toughness and impact, Mr. Bailey refers to the difficulty of comparing results from non-standard test-bars (from a "steel" point of view) with those from standard bars. Replying to one questioner, he admits to having possibly exaggerated early failures of nodular-iron components in the advance version of the paper. Dealing with crankshafts, the hardness reduction is queried as to its effect on machining. Again, the Author acknowledges information from Mr. Hallett on short-cycle annealing, which if completely effective, will enhance the material in the opinion of engineers vis-à-vis *malleable iron.*

Ductility Interpretation

Continuing his replies, the Author said that Mr. Morrogh had disagreed with his interpretation of the terms ductility and impact resistance. However he did not think that one could do better than quote the definition of ductility which had been agreed by the Iron and Steel Industry Standards Committee and which was embodied in BS 2094 (British Standards Institution, 1954).‡ Ductility was defined as "the ability of a material to undergo cold plastic-deformation, usually as a result of tension." Engineers called for ductility in their materials of construction, not because they considered ductility to be a measure of resistance to shock, but because they knew it to be a measure of the amount by which overloaded components of a structure could deform in order to redistribute the load between them, or of the amount by which a single component in a machine could deform locally to redistribute the stress across its section. One measure of the ability of a material to undergo cold plastic-deformation in tension was the percentage elongation at fracture of a standard test-bar when the load was increased slowly. He had chosen to use that measure because it was most easily obtained in practice; because it was the measure which was most widely used by engineers; and because nearly all the published information on the properties of materials gave their elongation at fracture but did not give their elongation at maximum load. Whether engineers and metallurgists were right in attributing so much importance to elongation at fracture was quite a different matter. His personal view was that elongation at maximum load was of greater significance, because most machines and structures would fail catastrophically if the maximum load which a particular major component would carry was exceeded; whether the component concerned would stretch another 5 or 10 per cent. after the maximum load had been passed was only of academic interest to the design engineer. He would have liked to have plotted the elongations at maximum load in Fig. 6, but the necessary information simply was not available for all the irons and steels the properties of which were embodied in those curves.

In order to show what a different picture elongation at maximum load could present, Mr. G. N. J. Gilbert of the British Cast Iron Research Association had kindly carried out some comparative tensile tests on similar bars in ferritic nodular cast iron and mild steel. The materials were as described in Table XIII.

TABLE XIII.—*Composition of Ferritic Nodular Cast Iron (per cent).*

Total carbon	3.27	Phosphorus	0.085
Silicon	1.90	Nickel	0.63
Manganese	0.27	Magnesium	0.070
Sulphur	0.033	Cerium	0.014

The ferritic nodular cast iron (composition as in Table XIII) was produced by the combined magnesium/cerium process, and was cast in keel blocks 15 in. long by 1¼ in. square. It was rendered fully ferritic by heating at 900 deg. C. for 14 hours, then cooling to 690 deg. C., where it was held for a

* Paper presented to the Institution of Mechanical Engineers and printed in the JOURNAL, May 20, 27 and June 3, 1954. Other discussion contributions were printed in the JOURNAL, February 24, March 3, 10 and 24, 1955.

† The Author is on the staff of Intelligence Division, London Headquarters, Department of Scientific and Industrial Research.

‡ British Standards Institution 1954 BS No. 2094. "Glossary of Terms Relating to Iron and Steel—Part I. General Metallurgical, Heat-treatment, and Testing Terms."

further 48 hours before being allowed to cool slowly in the furnace.

The En. 3 mild steel was supplied by the Metallurgy (General) Divisional Laboratory of the British Iron and Steel Research Association. The material (reference B.H.K. 15) was supplied in the form of 1¼-in. dia. bar in the as-rolled condition, and had the composition given in Table XIV.

TABLE XIV.—*Composition of En.3 Mild Steel (per cent.).*

Total carbon	0.24	Sulphur	0.021
Silicon	0.07	Phosphorus	0.020
Manganese	0.76		

The nodular cast iron was well below average in manganese content, and it had considerably less nickel than most of the nodular irons mentioned in the references given in the Paper: those deficiencies would tend to increase its elongation at fracture and to decrease its tensile strength.

Both materials had been tested first as standard 0.564-in. dia. bars of 2-in. gauge-length and 0.500-in fillet radius, as shown in BS 18, test-piece C.

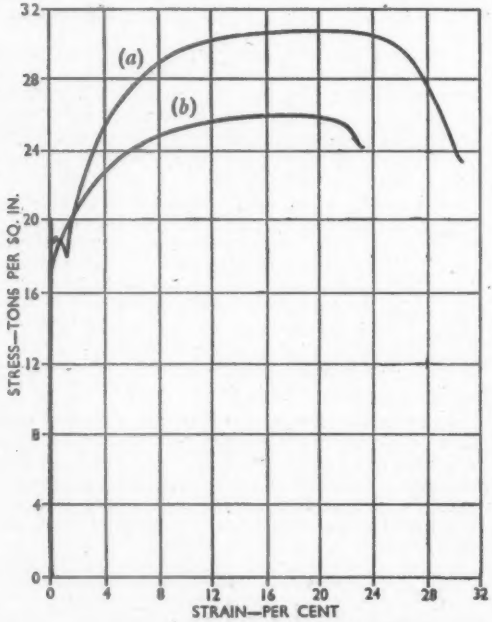

FIG. F.—*Stress/strain curves for mild steel and ferritic nodular cast iron; 4-in. gauge-length bars, 0.564 in. dia.; (a) mild steel, and (b) ferritic nodular cast iron.*

p. 11. They were then retested with the gauge-length increased to 4 in. The results of those tests were given in Table XV.

It was worth noting that although the mild steel

TABLE XV.—*Results of Tensile Tests* on Mild Steel and Ferritic Nodular Cast Iron.*

Material.	Gauge-length, in.	Ultimate tensile strength, tons per sq. in.	Elongation, per cent.	
			At maximum load.	At fracture.
Nodular iron	2	26.2	20	20
	4	25.6	21	20
Mild steel	2	32.4	22	30
	4	31.8	21	31

* Carried out by the British Cast Iron Research Association.

in the standard 2-in. gauge-length test-piece showed an elongation at fracture 35 per cent. greater than that of the nodular cast iron, its elongation at maximum load was only 10 per cent. greater. Furthermore, doubling the length: diameter ratio of the test-bars resulted in equalization of the elongations at maximum load, though the elongation of the steel at fracture was still 19 per cent. greater than that of the nodular cast iron. The difference in behaviour of the two materials was best illustrated by the curves in Fig. F. The pronounced necking exhibited by the mild steel made that material much more sensitive to changes in length: diameter ratio than was ferritic nodular cast iron. The stress/strain curve for the annealed nodular cast iron was much more like the stress/strain curve of an aluminium alloy than one of mild steel: it showed no yield point.

Had it been possible to plot in Fig. 6 elongation at maximum load instead of elongation at fracture, the curves would have been very different. In his opinion, the information they would have conveyed would have been of more value to engineers; but in the opinion of the average engineer, brought up to demand high elongation at fracture, they might perhaps be thought more useful as they stood.

Toughness

He could not fall back on BS 2094 for a definition of toughness, because there was no reference to the term there; but by toughness he understood resistance to failure under impact loading. He had purposely refrained from using the term in the Paper because it had not been defined. The value of the Paper would have been greatly increased by the inclusion of impact/energy transition curves, but at the time it had been written there had been no information available for nodular cast irons which would enable their performance to be compared with that of other materials. Gilbert's paper (1953), mentioned by Mr. Morrogh, referred to tests on non-standard impact specimens, as had all his subsequent reports which had been published up to the time of writing this reply. He had not been able to use Gilbert's results in the Paper for that reason, and he still could not use them, for no one had yet shown how to correlate the results of impact tests done on specimens of different size. However, since the Paper had been written, Carr and Steven (1953)† had published the results of impact tests on

† Carr, A. L., and Steven, W., 1953, "Impact Properties of Annealed Spheroidal Graphite Cast Iron," International Foundry Congress, Paris (reprinted in abridged form in *Metal Treatment and Drop Forging*, October, 1953).

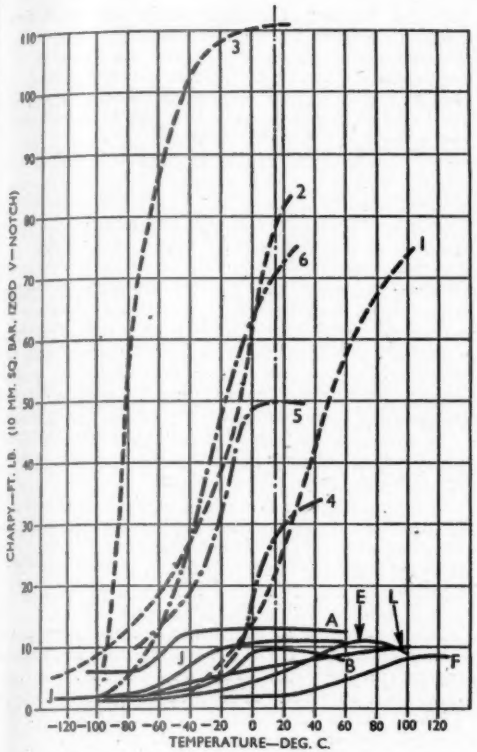

FIG. G.—*Curves showing variation of impact resistance with temperature.*

——— Ferritic nodular cast irons
– – – – Wrought steels
—·—·— Cast steels

standard specimens in a whole range of nodular cast irons, and he had been able to produce some curves which showed the variation of impact resistance with temperature for four of the materials shown in Fig. 13. Those curves were reproduced in Fig. G. All related to tests in a Charpy machine using a 10-mm. square-section test-piece having the standard Izod V-notch. The full curves gave Carr and Steven's results for six ferritic nodular cast irons containing 1 per cent. nickel. The broken curves, (1), (2), and (3), applied to wrought steels, and the chain-dotted curves, (4), (5), and (6), to cast steels. Full particulars of those irons and steels and of the sources from which the data had been obtained are given in an Appendix to Author's Reply. Bearing in mind that the impact resistance of ferrous metals was increased by deoxidation and by alloying with nickel and that deoxidation with aluminium was almost universal practice in steel foundries, he considered that it was fair to compare curve (6), for the 1 per cent. nickel cast steel deoxidized with aluminium, with curve (E) for the 1 per cent. nickel nodular cast iron deoxidized with magnesium and containing a rather similar percentage of manganese: the comparison did not favour the nodular cast iron. Those transition curves confirmed rather than refuted his statement that the impact resistance of nodular cast irons was poor compared with that of cast steels. As an engineer, he was not primarily concerned with the appearance of the fracture or with the temperature at which it changed from dark to bright: he was concerned with the magnitude of the blow which the material would withstand at the lowest temperature at which it was intended to use it. If that temperature was room temperature he would use Fig. 13; otherwise, he would use Fig. G, and he would bear in mind that the curves would be moved to the right if the rate of loading or the stress concentration at the notch was increased.

Where the relative resistance to shock loading of grey cast iron and nodular cast iron was concerned, Mr. Morrogh had read into the synopsis of the Paper a meaning which was not intended to be there at all. He (the Author) had never been in any doubt that as-cast nodular irons were superior in shock resistance to the best flake-graphite cast irons. But the shock resistance of ferritic nodular cast irons was so much better than that of as-cast nodular irons, that he would expect the former to be chosen in applications where shock resistance was important.

Copper Content

He was glad to hear that the combined magnesium/cerium process worked well with nodular irons containing copper, even in the presence of subversive elements. Unfortunately the price of copper had risen considerably of late, and at £360 per ton it was not a very attractive commercial proposition as a vehicle for carrying magnesium into liquid iron. Even scrap copper could not be obtained for much less than £240 per ton; and it had been £25 per ton in 1932. Copper was one of the metals which were becoming increasingly scarce and its use in electrical engineering was so important that non-essential uses ought to be discouraged. He hoped a more readily available alternative would be found, but he realized that the field of choice was not wide.

He agreed with Mr. Morrogh that proof-stress data were needed by engineers, and he was grateful to him for having provided such data in Table V. The proof stresses of the quenched and tempered nodular cast irons were particularly pleasing, and it was unfortunate that they were not accompanied by similarly outstanding fatigue strengths.

As Mr. Hallett had been one of the pioneers in the commercial production of nodular cast iron—indeed, he believed his previous company had been one of the first to try out the cerium process, and one of the first licensees of the magnesium process—he had some sympathy with his point of view. He had agreed with Dr. Pearce that, in the advance copy of the Paper, he had exaggerated the number of early failures and he hoped the final version would not be so objectionable to foundrymen. He would like to congratulate Mr. Hallett on his production of 20,000 nodular-cast-iron crankshafts without a single failure in service. That was a

Nodular Cast Iron—Discussion

remarkable achievement with a new material, but it must not be overlooked that the shaft concerned was fitted to a stationary Diesel engine: the crankshafts of such engines were usually very conservatively stressed, and the engines tended to operate at a constant speed, which made it easy to avoid torsional criticals. The fact that the shaft concerned had proved successful in service, yet had gone out of production in favour of a forged-steel shaft tended to confirm his own view that nodular-cast-iron crankshafts were not yet an economic proposition in Britain.

Heat-treatment

Mr. Hallett had added to the information given by Mr. Morrogh on the improvement in mechanical properties which could be achieved by quenching and tempering. However, where Mr. Morrogh's as-cast iron had a Brinell hardness number of 257 increasing to 331 after quenching and tempering, Mr. Hallett's as-cast iron had a Diamond pyramid number of 300 decreasing to 270 on quenching and tempering. In his opinion, the only mechanical property included in Table VIII which was of real importance in a crankshaft in service was the hardness figure, and on that basis the material air-cooled from 900 deg. C. was superior to that which had been oil-quenched and tempered. He wondered whether it could be that the machining difficulties with the material in the as-cast state were so great that the reduction of 40 points in hardness was made in deference to the production engineers. He was surprised to see that the notched fatigue strength had been omitted from Table VIII, for he considered that to be the most important property in a crankshaft material.

He had not stated either in the Paper or in his introductory remarks that nodular cast iron was usually annealed for 4 hours at 900 deg. C. What he had said was that the ferritic materials illustrated in Fig. 7 and referred to in Figs. 6, 10, 12, and 13 had been obtained by annealing the as-cast material for periods up to 24 hours at temperatures between 900 and 960 deg. C., but that the annealing time could have been safely reduced to 6 hours. That was correct as far as it went: he was mainly concerned with the cost of the heat-treatment process, and that was largely determined by the length of time at high temperature. The full heat-treatment cycle for the ferritic irons tested by Grant (1950) was 12 hours at 950 deg. C., cooled from 950 to 700 deg. C. in 8 hours, 5 hours at 700 deg. C., furnace cooled; and for those tested by Palmer and Gilbert (1953) up to 24 hours at 900 or 960 deg. C., slow cooling to 690 deg. C., 48 hours at 690 deg. C., furnace cooled.

He understood that the reason why such long high-temperature heat-treatments were used was to ensure that all carbides were broken down and the material rendered fully ferritic. If a comparatively short heat-treatment at a temperature as low as 690 deg. C. was all that was really necessary, the relative advantage of annealed nodular cast iron over malleable cast iron in cost of heat-treatment would be greater than he had implied. He was grateful to Mr. Hallett for pointing that out.

He would like to thank Mr. P. A. Russell for his illustrations of nodular-iron castings used in a shock-test rig, and noted what he had said about the designers having selected the material as being superior to any other material of equivalent cost which was available for castings. However, he would have liked to ask how those designers knew it was superior. On the evidence he had gathered together in the Paper and in reply to Mr. Morrogh, it was not superior. A load of 160 tons acting for 15 milliseconds sounded very impressive, but Mr. Russell had not given the impact energy in ft. tons, which had to be related to the size and resilience of the structure which sustained it. Unless similar castings made in a suitable steel had proved unsatisfactory in that application (which might perhaps be inferred from Mr. Russell's remarks, but which had not been explicitly stated), he did not consider that those illustrations proved Mr. Russell's point.

(To be continued)

Metallographic Analysis and its Application to Steel

Different methods developed for isolating carbides and non-metallic inclusions in steel, and especially the electrochemical principles for dissolving the metallic matrix without affecting the carbides, are described and discussed by Sakari Heiskanen in an article published in *Jernkontorets Annaler*, No. 139, 1955. The author points out that when the carbides are no longer in metallic contact with the ferrite, they are not protected by the less noble metal phase. He found appreciable dissolving of cementite not in contact with ferrite in weak acid solutions with *p*H as high as 2.5. An isolation method was developed in which a 1 per cent. solution of HCl in ethyl alcohol is employed. The apparatus and the method are described in detail. The method was found to give better results than those obtained with a neutral citrate solution. Micro-chemical methods for the determination of Fe, C, Mn, Cr and Mo are described, and electron micrographs of carbide particles are included.

Babcock & Wilcox Subsidiaries' Organization

Activities of two subsidiaries of Babcock & Wilcox, Limited, boilermakers, etc., of London, E.C.4, are to be merged. The companies affected are Spencer-Bonecourt, Limited, and the Clarkson Thimble Tube Boiler Company, Limited. The former's name has changed to Spencer-Bonecourt-Clarkson, Limited, and the company has assumed responsibility for all new business in Spencer-Bonecourt waste-heat boilers, the Clarkson marine and industrial waste heat, oil, and gas-fired boilers and oil-fired domestic boilers.

The chairman of the company is Capt. (E) W. Gregson, Mr. S. W. Spurr, managing director of the Clarkson company, becomes managing director, with Mr. A. E. Watkins as his deputy. The secretary is Mr. J. H. Worlledge.

AS FROM MARCH 28, the London office of the Butterley Company, Limited, will be at 9, Upper Belgrave Street, London, S.W.1 (telephone: SLOane 8172-3 and 9106-7).

Company News

WOLF ELECTRIC TOOLS, LIMITED—The directors recommend a 20 per cent. dividend in respect of operations in 1954, when group net profits expanded from £91,479 to £167,391. For the previous year the dividend was 17½ per cent. and absorbed £30,646, against the £35,023 required to pay the increased dividend for 1954.

SWAN, HUNTER, & WIGHAM RICHARDSON, LIMITED—In view of the date of the forthcoming Budget, it has been decided to post the final dividends on the preference and ordinary stocks on May 9. As announced previously, a final dividend of 10 per cent. is recommended on the £3,422,128 ordinary capital, as doubled by a free scrip issue last July.

BREEDON & CLOUD HILL LIME WORKS, LIMITED—Holders of the company's ordinary shares are to receive a final dividend of 25 per cent. and a special bonus of 2½ per cent. These, with the interim of 10 per cent., make a total distribution of 37½ per cent. for the year to January 31, 1955. In the previous year, on the present capital of £225,000 the equity final of 17½ per cent. made 25 per cent. There was no bonus.

SHOTTS IRON COMPANY, LIMITED—The summary of liquidators during the third year of the liquidation ended March 4, 1955, shows total receipts of £422,206, including interest on payments of compensation £50.838, final compensation for coal industry assets £260,699, and a distribution received from other interests in process of winding up of £35,350. Distributions of assets warrants cashed during the year totalled £373,660, while cash at March 4, 1955, amounted to £32,022 (£74,123).

ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED—CIC consent has been obtained to an issue of £1 ordinary shares at 40s. each to raise £10,300,000. Of the total of 5,172,413 shares to be issued, 4,957,000 will be offered to existing ordinary stockholders on the basis of one new share for each complete £4 of stock held. The remaining balance of some 215,000 shares will be offered to the employees of the AEI group of companies at the same price. The issued ordinary capital will thus be raised to the authorized £25,000,000.

G. D. PETERS & COMPANY, LIMITED, manufacturers of railway and road rolling stock equipment, of Slough (Bucks)—A final dividend of 3½ per cent. is recommended by the board, making 5 per cent. for 1954 on the £607,500 one-class capital as increased by a 300 per cent. free scrip issue. The total is equivalent to the 20 per cent. paid on the old capital for 1953. Net profits, after tax, are given as £54,253, compared with the previous year's figure of £75,065. The board states that the order-book was slow in appreciating during the early part of the year, largely due to exchange differences affecting certain export orders.

Board Changes

WICKMAN, LIMITED—Mr. E. A. Hyde, a director of the company, has been appointed deputy managing director. Mr. W. V. Hodgson, also a director of the company, has been appointed assistant managing director.

HOPKINSONS, LIMITED—Mr. G. M. Wells and Mr. I. G. Hopkinson have been appointed directors. Mr. Wells joined the company in 1934 and has held the position of London manager since 1939. Mr. Hopkinson, who joined the company in 1938, has been works manager since 1947.

Parliamentary

Chemical Engineering

The Parliamentary Secretary to the Ministry of Works, as representing the Lord President of the Council, was asked by MR. WILLEY what action had been taken to implement the recommendations of the report of the Committee on Chemical Engineering Research.

MR. BEVINS, in reply, said that, as had been previously stated, representative industrial bodies had been consulted and had made a detailed survey of the information and resources available in industry. This survey had now been completed and it was hoped that the trade associations concerned would soon put forward definite proposals.

In a further question MR. WILLEY asked what specific chemical engineering research was at present being carried out by the Department of Scientific and Industrial Research.

He was told by MR. BEVINS that several stations of the DSIR carried out work in the field of chemical engineering in developing processes and operations which had been studied in the laboratory. For example, the Fuel Research Station was studying the removal of sulphur from flue gases. Further details of such work, he said, would be found in the forthcoming annual report of the department.

Studies in the Economic Sphere

Mr. Mikardo asked the Parliamentary Secretary to the Ministry of Works, as representing the Lord President of the Council, what steps had been taken to put into effect the suggestions in paragraphs 13 and 14 of the report of the Department of Scientific and Industrial Research for 1947-48 that research associations might undertake studies of consumer need research, costing systems, and other subjects bordering on the economic sphere.

MR. BEVINS, in a written answer, said that in recent years research associations had given considerably increased attention to subjects bordering on the economic sphere. Their main effort in this sphere had been in two directions. The first was the economic assessment of improvements in industrial processes arising from the application of research. This type of assessment, based on first-hand study of industrial conditions, was now conducted by most research associations, particularly in the field of fuel economy and the saving of expensive raw materials. The second was studies in the field of production economics being carried out in eight research associations.

ELEVEN REGULATIONS had so far been made under the Factories Acts requiring the periodical medical examination of persons employed in processes which gave rise to dust which was injurious to health, said Mr. Watkinson, Parliamentary Secretary to the Ministry of Labour and National Service. Periodical medical examination of persons employed in dusty processes in four industries which gave rise to pneumoconiosis risks was required by Regulations made by the Minister of Pensions and National Insurance.

Recent Wills

BOOTH, H. C., the inventor of the vacuum cleaner, and the founder and former chairman of the British Vacuum Cleaner & Engineering Company, Limited £80,935

MARTIN, H. S., formerly chairman of the Glamorgan Hematite Iron Ore Company, Limited, Cardiff, and consulting mining engineer to the Central Mining Corporation, Johannesburg £111,269

British Resources

An optimistic view of British resources, other than manpower, was taken by Sir Charles Goodeve, director of the British Iron and Steel Research Association, when he opened a weekend conference organized by the British Institute of Management and local branches of the Institute of Industrial Administration at Southport. Sir Charles stressed our mineral reserves, climate favourable to high agricultural productivity, concentration of industry in compact areas, seaports within 100 miles of every factory, a geographical position midway between east and west, and membership of the Commonwealth.

He urged that when managements were assessing the risk of a capital re-equipment scheme they should not overlook the risk of inaction.

The training of managers to meet the advances in science and technology of control and communication brought about by electronics was discussed by Mr. D. R. O. Thomas, chief education officer of the United Steel Companies, Limited, who said that many boys were leaving grammar schools at 16 instead of staying on to benefit from a full sixth-form course and the other advantages of a school life at that level, simply because it was the practice to start engineering apprenticeships at 16. This situation could only be altered by industry itself.

Secondly, owing to the requirements of certain faculties at the universities, notably science and engineering, it was a common practice at schools for pupils to concentrate for the GCE examination at advanced level on three subjects instead of developing a broad field of studies in the sixth form. There were many critics of this practice both in the schools and the universities.

BTC's Railway Freight Charges Scheme

The new maximum charges scheme for merchandise sent by rail was issued on March 21 by the British Transport Commission. The commission believes that it will enable the railways to compete on an even footing with their principal competitor, the private enterprise road haulage industry, whose rates are not subject to statutory control. The maximum charges will form a basis for negotiation with individual traders, and the railways will be given freedom to negotiate, whereas in the past the charges were published for all to see. The draft scheme will go before the Transport Tribunal for approval and a public inquiry will be held before it comes into operation.

The scheme covers charges and terms and conditions of carriage for all merchandise and livestock traffic by goods or passenger train service, except passengers' luggage. The charges to be made are left to the BTC's discretion, which will be exercised commercially.

The maximum charges for merchandise, including coal and other minerals, carried by goods train relate to about 85 per cent., in terms of present-day receipts, of the traffic covered by the scheme. The commission explains that they are not truly comparable with the present standard charges, which were designed to provide a standard revenue, but are set out in a series of scales regulated by the weight of the consignment and what is termed its "loadability"—the ease with which a consignment can be loaded.

Once the scheme is approved by the tribunal most of the existing rates will continue in force for the time being to enable a systematic review of them to be made.

Iron-ore Imports

Iron-ore imports in February, and the total for the first two months of this year compared with the corresponding period of 1954, are shown below.

	Month ended February 28.	Two months ended February 28.	
	1955.	1954.	1955.
	Tons.	Tons.	Tons.
Sierra Leone	41,765	112,039	74,435
Canada	27,670	133,830	80,011
Other Commonwealth countries and Eire	564	1,112	2,483
Sweden	259,743	639,031	572,633
France	42,535	81,112	82,853
Spain	60,724	60,173	97,697
Algeria	149,965	318,081	309,919
Tunisia	39,680	65,746	108,474
French Morocco	16,828	40,057	43,306
French West Africa	38,193	102,564	66,357
Spanish Morocco	24,200	38,833	29,600
Liberia	28,910	35,789	48,330
Brazil	25,575	43,865	43,560
Other foreign countries	21,840	60,259	33,541
TOTAL	778,192	1,732,491	1,593,219

Need for More Exports to Canada

Lord Rochdale, president of the National Union of Manufacturers, who has recently returned from a visit to Canada on his way back from a business trip to Australia, has advised British manufacturers to take more interest in exporting to Canadian markets. The high cost of production in Australia, coupled with preferential tariff arrangements for UK imports, made the Australian market a very attractive one, and manufacturers could hardly be blamed for going where business was good, he said. On the other hand the margin between Australian and UK production costs was narrowing as Australian efficiency improved and wages in this country rose. The import restrictions recently announced by the Australian Government emphasized the necessity for British manufacturers to look beyond Australia.

This certainly underlined the importance of Canada, added Lord Rochdale, and we could not afford to fluctuate on a market made so highly competitive by keen and persistent effort from the United States.

Bill to Assist Directors

A private member's Bill, the object of which is to ensure the application to directors and officers of limited companies of the principle of the Common Law that in case of criminal proceedings the onus of the proof must rest with the prosecution, is being sponsored by Mr. F. P. Crowder, the Conservative member for Ruislip-Northwood, who is a barrister. The text of the Directors, etc., Burden of Proof Bill was published on March 23.

LORD CHANDOS, president of the Institute of Directors, opened the Institute's new headquarters in Belgrave Square, London, recently. Membership of the Institute has doubled to 14,000 in the last year and continues to expand rapidly. Emphasizing that the new building would not be a club, Lord Chandos said: "I hope this will be a centre to which directors will naturally gravitate when they have finished with their shareholders and their solicitors."

Notes from the Branches

Scottish

The annual general meeting of the Scottish branch of the Institute of British Foundrymen was held on March 12 at the Royal Technical College, Glasgow. Mr. John Bell, the president of the Institute, and Mr. G. Lambert, the general secretary, were present. After the minutes of the previous annual meeting were accepted, Mr. A. Marshall, in presenting his annual report, said, *inter alia*:—

Secretaries Report

The branch continues to be one of the most active in the Institute, but, frequently changes can be noted in the personnel at meetings. Many of the older members are absent or less regular in their attendances and many young men have taken their places. The total attendances at the meetings have decreased slightly, but so long as the young men are coming forward as they have been doing during the past few years there is no need to fear for the work which the branch is being called upon to do nor the efficiency with which that work is being done.

An examination of the analysis of membership shows that during the year the branch lost eight associates and gained seven associate members, making its total membership 497. Over the last few years it appeared to hover round the 500 mark and it may be that for some time to come this will be the average figure, but whilst numbers are not everything it is always encouraging to find the membership steadily growing.

The number of deaths this session was six. Of these, Mr. D. H. Young and Mr. James Steven were members. Mr. E. Cunningham, Mr. James Nicholson, Mr. R. L. Rankin and Mr. R. Ure were associate members. Mr. Steven joined the Institute in 1936 and whilst he was not a regular attender, those who came in contact with him appreciated his kindly nature and his ability as a foundryman. Mr. D. H. Young was known to a large number of members, both in Scotland and on the other side of the border. His sudden death last June came as a great shock to all who knew him. "Harry" Young, as he was known, will always be remembered for the work he did as president of the branch, as Council member, and for the many papers he presented to the Institute. Mr. E. Cunningham was another old foundryman and was perhaps better known in the Falkirk area, but those who came in close contact with him recognized his abilities and his aptitude for getting on with his fellow men.

Mr. James Nicholson, whose sudden death took place while on a holiday abroad, was recognized as a clever foundryman and a man of very high character. Mr. R. L. Rankin and Mr. R. Ure were two very old members. Mr. Rankin claiming the distinction of being a founder member, having joined the Institute in 1904. Mr. Ure joined the Scottish branch of the Institute in 1920 and both of these gentlemen will be sadly missed by many of the friends with whom they came in contact.

Attendances at the branch meetings show a slight falling-off when compared with last session. The largest attendance was 63, consisting of 55 members and eight visitors, while the smallest was 42 members. The average attendance of Council members was 12. During the session, four Council meetings were held, the same number as last session. The highest attendance was 15, the lowest 10, and the average 13.

Section Activities

The meeting with the Dundee Institute of Engineers was again a very successful gathering and on this occasion was addressed by the president, Mr. Daniel Brown. He was well supported by a contingent of members from the west, while the local members, resident north of the Tay, were there in full force. The effect of all these Dundee meetings is now beginning to show and Mr. Brown had the pleasure of addressing a very enthusiastic audience. This will certainly continue to be a worthwhile effort and the development of the North-Eastern section is looked forward to with confidence.

Meetings of the Falkirk section were under the guidance of Mr. J. A. McIntosh and, with the help of the local Council and Mr. A. Bulloch, as hon. secretary, a very successful session has been held.

This year no paper was recommended for the award of an Institute diploma as the Council considered that the papers presented during the session did not comply with the conditions governing such an award.

The "Sir Archibald McInnes-Shaw" prizes were again awarded to the successful students in foundry practice and patternmaking in the Stow College. The winners were:—

In foundry practice ... Mr. John Ferguson.
In patternmaking ... Mr. Alex Reid.

Both were invited to attend the opening meeting in October when they were congratulated on their success.

Mr. James McPheat has brought another honour to the branch in being elected vice-chairman of the Technical Council and Mr. William Montgomery will act as his deputy council member, and to both these he expressed appreciation of their past work.

This year the branch members had the honour of acting as hosts to the members and friends on the occasion of the Institute's annual conference which was held in Glasgow during June, 1954. This conference created a record registration, there being approximately 750 people participating in it and, at the annual banquet, 650 people took part. It was with great pride and enthusiasm that the members of the Scottish branch witnessed Mr. John Bell being installed as national president. The branch fully appreciates the tremendous influence he has exercised in its growth and many foundrymen can well remember, as young men, how they came to him for advice and ever found him willing and anxious to let them have the benefit of his experience. Indeed, one well-known foundryman from south of the border summed up his work in the following words, "ask John Bell to walk a mile with you and he will walk two."

Endowment

In recognition of Mr. Bell's work it was agreed that if, after all other commitments had been made, there was left a surplus from the conference fund, it should be used to endow a travelling scholarship in his name. This scholarship has now been endowed at the Royal Technical College and Mr. Bell had the honour of handing over to the chairman of the governors, Sir Andrew McCance (a member of the branch), a cheque for £1,700. This year at the International Conference being held in London, Mr. Bell will have the pleasure of presenting this prize to the first winner of this scholarship.

Mr. George Lambert, who succeeded the late Mr. Makemson, has carried on this work with enthusiasm, and it will be recognized by all members that they have indeed been fortunate in having a man such as Mr. Lambert to fill this post.

This session, for the first time, the branch held a dinner/dance in the Grosvenor Restaurant. Although it was held very near Christmas—December 18—it can now be reported that it proved to be an outstanding social success. All reports indicate that everything

went well and everyone had an enjoyable evening. In this respect a great deal of the success of the evening was due to Mr. Brown, the branch president, who, with Mrs. Brown, mixed with their guests and saw to it that everyone was brought into the round of social activity.

The branch dinner was held as usual in the Grosvenor Restaurant, following the business meeting. There was a good attendance, at which Mr. John Cameron, O.B.E., the then branch president, was in the chair. He was accompanied at the high-table by Mr. Longden, president of the Institute during session 1953-54, and also Mr. Bell, senior vice-president, Mr. Makemson, general secretary, and Mr. Lambert, assistant general secretary.

Congress Activities

In June this year the International Congress will be held in London and a post-congress tour has been arranged. The Scottish branch will act as hosts when the visitors come to Scotland and a round of works visits has been arranged for them. The ladies will be taken on a 'bus tour of the three Lochs. On the evening of Monday, June 27, there will be a dinner held at the Grosvenor Restaurant, at which the Scottish branch will act as hosts to the visitors. It is hoped many members will attend this dinner. Full details of the post-congress tours will be issued at a later date from the general office.

This year the branch has indeed been fortunate to have as president Mr. Daniel Brown, and those who have known him for some years knew that when he did obtain presidential rank he would fill this office with distinction. It will be recognized that during his presidential year the branch has taken another step forward in the affairs of the Institute. As he steps out to make way for his successor, he adds another name to a long and growing list of worthy men who have held presidential rank in the branch.

Election of Officers

During the meeting, the following officers were elected for the 1955-56 session.—As *president*, Mr. J. M. Douglas; as *senior vice-president*, Mr. H. J. M. Connacher; as *junior vice-president*, Mr. A. S. H. Sawers; as *members of Council*, Mr. R. Carswell, Mr. R. Ferguson, Mr. H. Hart; as *representatives to General Council*, Mr. D. Brown, Mr. John Cameron, O.B.E., Mr. J. Cormack, Mr. A. S. H. Sawers; *as representative to Technical Council*, Mr. James McPheat; and as *hon. secretary*, Mr. A. Marshall.

Publications Received

Department of Scientific and Industrial Research. —Report for the year 1953-54. Published by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 9s. net.

As usual the Report contains excellent accounts of the work of the various research associations. The British Non-Ferrous Metals Research Association tells of investigations into LM-4 aluminium casting alloy which show the specified limit of 0.5 per cent. zinc can be increased without detriment to its strength, ductility and corrosion-resisting properties. The account of the work of the British Cast Iron Research Association shows that it is operating in an ever widening sphere. *inter alia*, it carries a warning against the use of vitreous-enamelled scrap in cupola charges when making bath castings, as it is associated with cracking.

A report from the British Steel Castings Research Association appears for the first time. It tells of new work undertaken with the object of minimizing the dust hazard arising from the use of swing-grinders. A film is being produced showing its effectiveness.

The Building Research Association comes in for some criticism from the Department, for it says: "the building industry as a whole does not appear to make so large a contribution to research for its benefit as do most industries, and as it might do."

Federation of Rhodesia and Nyasaland—an Economic Survey. Published by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 5s. net.

This Report is of interest to the foundry industry as the Federation already has the nucleus of an iron and steel industry, for it now possesses two steel and about 40 or more iron foundries. Moreover there is a blast furnace plant at Que Que, which has to make a variety of irons. There are two furnaces having 9-ft. dia. hearths, and two steel furnaces of 25 and 75 tons capacity. It is intended to increase the iron production from 40,000 to 80,000 tons per annum. The output of steel is to go up from 30,000 to 56.000 tons yearly. Of interest too is the manufacture of low-carbon ferro-chromium—the grade used in the manufacture of stainless steel. The Report shows clearly that the major competition for UK goods is from the Union of South Africa. The section devoted to the *modus operandi* of selling to both the European and native market is lucidly set forth. The native market is constantly growing and needs careful attention by the home manufacturers.

Some Recent Advances in Tinplate Manufacturing Processes, by W. E. Hoare, D.Sc.(Eng.), F.I.M., A.I.Prod.E. Published by the Tin Research Institute, Fraser Road, Perivale, Greenford, Middlesex.

This 27-page book is a reprint of an address given at the 9th International Congress on packaging held at Parma, Italy, in September, 1954. The paper is a review of the present stage of development of tinplate manufacturing methods. The section on electrolytic tinplate describes all the processes used and the differences in the products. There is a chart showing the production method operating in each electrolytic tinplate works throughout the world. Hot-dipped tinplate production methods are everywhere being brought into line with the latest technical developments. Some of the methods in use for testing coatings on tinplate are also mentioned. There are twelve photographic illustrations.

Engineering Manual for Control of In-plant Environment in Foundries. Published by the American Foundrymen's Society, Golf and Wolf Roads, Des Plaines, Ill., U.S.A.

This publication is divided into sections 2 and 3, the former entitled "Exhaust Hoods and Exhaust System Design" and the latter "Practical Design of Sand-Handling Ventilation Systems." In section 2 a practical approach is made to the by no means simple business of installing exhaust hoods which will serve their intended purpose. To help designers there are nomographs, abundant tables and charts.

The third section is likewise informative and contains a table occupying more than a page which gives the usual ventilation rate for every item normally installed in a mechanized moulding plant. Moreover, diagrams and illustrations are given showing the type of exhaust to instal. This brochure contains information which is very difficult to locate and the reviewer congratulates the AFS committee on doing a very useful piece of work.

Personal

Mr. F. H. BEASANT has resigned from the board of the Anti-Attrition Metal Company.

Mr. S. HARRIS, of Rotherham, has been appointed vice-president of the British Iron, Steel and Kindred Trades Association.

Dr. R. W. K. HONEYCOMBE, senior lecturer in physical metallurgy at Sheffield University, has been appointed to the Chair of Physical Metallurgy.

THE ROVER COMPANY has announced the appointment of Mr. Charles T. BUSCH as chief accountant covering the company's home and overseas operations.

Mr. EDWARD L. DENNY, chairman of Wm. Denny & Bros., Limited, Dumbarton, has accepted an invitation to join the board of the India General Navigation & Railway Company.

Mr. J. D. MOSLEY, formerly a supervising engineer of the erecting department of the Metropolitan-Vickers Electrical Company, Limited, is now the company's district erection engineer for London.

Mr. A. O. BLUTH, a director of Vickers Armstrongs, Limited, and of Erlangers, Limited, and vice-chairman and joint managing director of the Jack Olding Organisation, has joined the board of Vickers, Limited.

Dr. MARJORIE SWEETING, lecturer in geography at Oxford University, has been granted the Royal Geographical Society's Gill Memorial award for her contribution to the physiography of limestone areas.

Mr. W. W. FRANKLIN, a director and chief engineer of Davy & United Engineering Company, Limited, Sheffield, will accompany the British Mission to India in April to study the possibility of establishing a large steelworks there.

Mr. J. A. R. PIMLOTT, an Under-Secretary of the Board of Trade, has been seconded to the Monopolies and Restrictive Practices Commission and has been appointed secretary in succession to Mr. WILLIAM HUGHES, who is returning to the board.

Sir WALTER MONCKTON, Q.C., Minister of Labour and National Service, has appointed Mr. A. T. S. ZEALLEY to be a director of Remploy, Limited, the company established by the Government to provide sheltered employment for severely disabled persons.

Mr. B. W. LYNN, chief inspector of F. Perkins, Limited, Diesel engineers, of Peterborough, has been appointed purchase controller in succession to Mr. G. F. LAURENCE. Mr. Lynn's successor is, Mr. G. BIRD, who has been deputy chief inspector for the past three-and-a-half years.

Mr. D. CHERRY PATERSON, chairman of Paterson Hughes Engineering Company, Limited, left for South Africa by air recently. He will be visiting various parts of the Union and will be mainly in Johannesburg at the offices of the company's subsidiary Paterson Hughes Engineering S.A. (Pty.), Limited.

Mr. F. D. NICKELL-LEAN has been elected president of the Bradford Chamber of Commerce, in succession to Mr. G. U. AVERDIECK. He has been a member of the Council of the Chamber since 1938, and has been chairman of the Chamber's Transport Committee for a number of years. He is chairman of Heaton & Flint, Limited, textile engineers, Keighley.

WICKMAN, LIMITED, announce that Mr. E. A. HYDE, M.I.I.A., has been appointed deputy managing director, and Mr. W. V. HODGSON, M.I.P.E., has been appointed assistant managing director. Mr. Hyde, who joined the company in 1944, has been financial director since 1945. Mr. Hodgson, who joined the company in 1947, has been general manager of the machine-tool division since 1949, and was appointed to the board in 1953.

(*Continued at the foot of Col.* 2)

Sir WILFRID AYRE, chairman of the Burntisland Shipbuilding Company, Limited, is relinquishing his additional office of managing director on Friday. He is also giving up the chairmanship of the subsidiary, Hall, Russell & Company, Limited, although remaining a director, and he will be succeeded in this position by the subsidiary's managing director, Mr. HOWARD JOHNSON, who will also become managing director of the parent company. The general manager of Hall, Russell & Company, Mr. JOHN WRIGHT, succeeds him as that company's managing director.

Obituary

Mr. ALBERT V. ROBINSON, who has died at the age of 57, was works manager of E. Green & Sons, Limited, makers of fuel economizers, of Wakefield.

Mr. GEORGE WESLEY COSTAIN, principal of George W. Costain, chartered constructional engineers, of Birmingham, has died at the age of 72. He was a past-chairman of the Midlands branch of the Institution of Constructional Engineers and a past-president of the Midlands section of the Junior Institution of Engineers.

Mr. HERBERT F. CRAGGS, chairman and managing director of the Goole Shipbuilding & Repairing Company, Limited, which he founded 53 years ago, died on March 19. Among his business interests was the chairmanship of Clelands (Successors), Limited, Wallsend, and Brown's Shipbuilding & Dry Dock Company, Limited, Hull.

Productivity Council Re-constituted

The British Productity Council is to have a president for the first time and five vice-presidents. Lord Bennett of Edgbaston has accepted the Council's invitation to be its first president and the heads of the organizations most closely concerned with productivity will become vice-presidents. Lord Bennett has for many years been a notable public figure in Birmingham and, as the title he took when he was created a baron in 1953 suggests, he has been connected with Edgbaston in particular. Until his elevation to the peerage he had represented the constituency as a Unionist MP since 1940. On the industrial side he is joint managing director of Joseph Lucas Industries, Limited, and was formerly a director of Imperial Chemical Industries, Limited, and Lloyds Bank. He is a past-president of Birmingham Chamber of Commerce. He is a former chairman of the British Productivity Council and is a previous president of the Federation of British Industries, whose president-elect, Sir Graham Hayman, is one of the new vice-presidents of the Council.

The trade unions' representative vice-president is Mr. C. J. Geddes, chairman of the TUC, while Mr. Charles Connell, president of the British Employers' Confederation, has also accepted office. The other two vice-presidents of the Council are Lord Rochdale, president of the National Union of Manufacturers, and Sir Eric Carpenter, president of the Association of British Chambers of Commerce.

Sir Walter Puckey, president of the Institution of Production Engineers, and a director of the British Tabulating Machine Company, Limited, has been elected to serve as a member of the Council.

News in Brief

A NEW OFFICE BLOCK is being built for Mitchell Engineering, Limited, on a site on the south-east side of the Town Bridge, Peterborough.

A PURCHASE of 30,000 tons of steel and 50,000 tons of iron ore has been made by the Royal Netherlands Blast Furnaces and Steel Factories from Canada.

THE FOURTH Scottish conference to be organized by the British Institute of Management will be held at Turnberry, Ayrshire, from May 20 to 21.

A PRIMITIVE CRUCIBLE for bronze-working, found on Castle Hill site, Thurgarton, near Southwell, Notts, is thought to be 1,000 years old, and a unique discovery.

THE RECEIPT of an illustrated wall-calendar from Allis-Chalmers, Inc., the well-known American firm of engineers and foundrymen, is acknowledged with thanks.

A LARGE GRAPHITE DEPOSIT of grades between 7 and 9 per cent., and at least 150 ft. thick, has been discovered about 50 miles from Hull, in the Canadian Province of Quebec.

ON BEHALF of Greek clients, Goulandris Bros., London, has placed an order with the Blythswood Shipbuilding Company, Limited, Glasgow, for a motor-cargo ship of 11,600 tons d.w. Delivery is scheduled for the spring of 1957.

THE ANNUAL SPRING MEETING of the Institute of Welding is being held from April 28 to 30 in the East Midlands area and it will comprise, as usual, a number of works visits and technical sessions, the latter being held at the University of Nottingham.

HARDINGE MACHINE TOOLS, LIMITED, Feltham, Middlesex, subsidiary of Sheepbridge Engineering, Limited, have opened a new depot stock of collets, feed-fingers, bushes, etc., at 18-19, Jennens Row, Birmingham, 4.

TO HELP in making wire ropes, an annealing pot 6 ft. 9 in. tall and 3 ft. 4 in. dia., with a wall thickness of ¼ in., has been made by Edgar Allen & Company, Limited, in heat-resisting steel. A steel casting ⅝ in. thick forms the bottom.

THE THIRD Safety and Factory Efficiency Exhibition will be held at Bingley Hall, Birmingham, from June 24, and will remain open for a week. In addition to the usual features there is to be a Paper—"An American View"—from the Centre for Safety Education, New York University.

A BOOKLET containing 22 pages of tables for the conversion of British weights into kilograms has been produced by Davidson, Park & Speed, Limited, steamship agents and brokers, 91, Bishopsgate, London, E.C.2. Called the "Kilo Book," copies are available on request to the company.

METAL INDUSTRIES (SALVAGE), LIMITED, are to resume operations on the sunken German warships in Scapa Flow at the end of the month. They have bought the former German cruiser Karlsruhe, which lies off the island of Cava. A sixty-ton floating crane from Faslane, in the Gareloch, will be used in the salvage work.

AT THE conference on Individual Efficiency in Industry, being held at St. John's College, Cambridge, from March 31 to April 2, Mr. Kenneth Marshall, M.A., director of the Joint Iron Council, in association with Mr. W. D. Seymour, of the University of Birmingham, will open a discussion on Industrial Training Problems.

THE WORLD BANK has entered into a formal agreement to lend $10,000,000 to the Industrial Credit and Investment Corporation of India, Limited, a corporation newly formed by private investors of India, the United Kingdom, and the United States to assist the growth of private industry in India.

A NEW ENGINEERING SCHOOL is to be built by Imperial Chemical Industries, Limited, at a cost of over £100,000, at Billingham-on-Tees. The school will be equipped with a furnace, lathes, welding sets, etc., and will also provide facilities for drawing office training. It is expected to be completed in June next year.

DUE to the increased demand for "Susgra" colloidal graphite dispersions, it has been found necessary to expand the production capacity of the plant. Recent additions to the production space may be expected to enable Colloidal Graphite, Limited, 6/7, St. Dunstan's Lane, London, E.C.3, to cope with current and potential demands for their specialities.

A SISTER SHIP to the three 22,000-ton vessels for which orders have been placed by the Cunard Steam-Ship Company, Limited, from John Brown & Company, Limited, since the war, has been ordered from the Clydebank company. The new ship is to be named Sylvania and delivery is expected in 1957. The cost is reported at about £5,000,000.

AERO RESEARCH, LIMITED, Duxford, makers of "Araldite" epoxy resins, state that greatly increased output of these products has made it possible to reduce manufacturing costs and prices. These reductions, which apply to nearly all forms of the resin, operate from March 28, and copies of the new price list are obtainable from the manufacturers.

A MAIL LINER for the South African service has been ordered from Harland & Wolff, Limited, Belfast, by the Union-Castle line. The vessel will be of similar size and power as the 28,705-ton gross Edinburgh Castle, which was completed in 1948. Recently Belfast shipyard workers staged a demonstration in protest against an alleged threat of redundancy.

PLATT BROS. & COMPANY, LIMITED, the Oldham textile engineering concern, has been informed by the USSR trade delegation in Britain that the Russian importing agency is to make modifications to contracts placed with the company a year ago. A director of Textile Machinery Makers, Limited, of which Platt Bros. is a constituent company, is to visit Moscow to clarify the position.

BECAUSE a Belgian shipbreaker considered a marine auxiliary engine built by Mirrlees, Bickerton & Day, Limited, too good to scrap after 40 years at sea, it has been installed in one of the floating cranes in the Antwerp shipyard. This three-cylinder Diesel, developing 15 h.p. per cylinder, was despatched in 1910 as part of the equipment for the Euripides, which was launched in 1914 for the Australia run and was renamed Akaroa in 1932.

GRIFFIN & GEORGE, LIMITED, Kemble Street, Kingsway, London, W.C.2, will be exhibiting at the Physical Society Exhibition, Royal Horticultural Hall, Westminster, from April 25 to 28 (stand No. 92). Among many exhibits of interest to foundry laboratories will be the BISRA-pattern mercury-cathode apparatus for the determination of small quantities of aluminium, vanadium, titanium and zirconium in high-chromium and other alloy steels.

G. WADDINGTON & SON, LIMITED, Hull, manufacturers of industrial gloves, are again showing at the Factory Equipment Exhibition at Earls Court. A range of gloves for medium, heavy, and light industry includes the economically-priced "300" patterns, which are bulk produced at the firm's extension factory

(Continued on page 362)

TWW
MOULDERS' SUNDRIES
FOUNDRY COKES and COAL DUST
PIG IRONS, FOUNDRY & FORGE
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GANISTERS LIMESTONE and FLUORSPAR
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FS/14

News in Brief

(*Continued from page 360*)

at Cottingham. A handbook is being distributed which, *inter alia*, gives useful information for the benefit and guidance of industrial-glove users and buyers.

RECORD PRODUCTION of 1,066,000 tons of coke, 966,000 tons of pig-iron, and 1,116,000 tons of steel ingots was established by Australian Iron & Steel, Limited, the chief subsidiary of the Broken Hill Proprietary Company, Limited, in the year to November 30, 1954. This success is attributed to the additional plant installed at the Port Kembla steelworks and the company's south coast collieries and the absence of serious industrial interruptions.

THE INSTITUTION OF MECHANICAL ENGINEERS announce that a Joint Conference on Combustion will be held at Boston, Massachusetts, USA, from June 15 to 17, and in London from October 25 to 27. A paper on "Advances in Cupola Combustion" is to be given by Professor G. A. H. Jungbluth and Professor K. Roesch. Details of the conference may be had by writing to the secretary of the Institution at 1, Birdcage Walk, London, S.W.1.

TWO FELLOWSHIPS at Cambridge University, one in physics tenable in the Cavendish Laboratory and one in engineering tenable in the Department of Engineering, have been offered in the name of the Metropolitan-Vickers Electrical Company, Limited, and the British Thomson-Houston Company, Limited, as endowments in a seven-year covenant with the University to the gross annual value of £1,250 to permit the salaries of those appointed to the fellowship to be in the range of £900 to £1,400 a year.

A JOINT SYMPOSIUM on the "Use and Welding of Aluminium in Shipbuilding" is to be held in London at the Institution of Naval Architects on December 7 and 8. An organizing committee has been established, representing the Institute of Welding and the Institution of Naval Architects, the British Shipbuilding Research Association, the British Welding Research Association and the Aluminium Development Association. The secretary of the symposium is Mr. G. Parsloe, the secretary of the Institute of Welding.

INDUSTRIAL PRODUCTS constitute about $23,000,000 in the $37,000,000 worth of goods which Poland is to export to Germany under the agreement signed last month covering the period to June 30 next year. Included is $5,000,000 worth of coal and chemical products. In return Germany is to send Poland goods worth $34,000,000, which include iron and steel products worth about $9,000,000. Germany has also concluded a trade agreement with Pakistan and is including non-ferrous metals and ferro-alloys, tools, and chemicals in her exports.

THE EXPORT CREDITS GUARANTEE DEPARTMENT announces that it is taking another step in restoring cover for exports to Iran; this follows the recent lowering of ECGD premium rates for this market. The main effects will be that exporters to Iran will now be able to obtain pre-shipment cover (previously restricted to "medium term" business) on contracts involving short credit terms of payment; the waiting period before ascertainment of loss under certain of the risks covered will be reduced from 9 to 6 months; and limits on the amount of cover available have been removed.

AMONG THE EXHIBITS shown by Armstrong Whitworth (Metal Industries), Limited, at the Leipzig Spring Fair (February 27 to March 9), 1955, one of the most outstanding was a No. 25 Kue-Ken Jaw Crusher, claimed to be the most powerful and economical for its size and weight. On this stand were also shown some examples of Closelòy cast rolls which are well known throughout the world, the particular exhibits being a pair of finishing rolls for a 15-stand semi-continuous hot-strip mill; a billet roll for the last stand of a 6-stand Morgan continuous mill, and a 3-high mill roll for finishing 5 by 3 in. joists.

BY CONCENTRATING too much on the purely technical and mechanical aspects of their work, technical colleges were in grave danger of producing robots instead of men, Sir Arthur J. G. Smout said at the annual prize giving of the Wednesbury Technical College on March 22. He added that it was as important to develop the qualities of resource, initiative and self-reliance as it was to fill the mind with facts and figures. A more liberal education of the scientist, the technician, and the technologist was required to combat the unbalanced system which had developed during the past fifty years.

WITH THE TITLE, "Focus on Effort," the fact that electrical aids to productivity make a great contribution to the reduction of human effort in industry, will be demonstrated practically on the stand of the British Electrical Development Association (Stand D.48) at the Factory Equipment Exhibition, Earls Court, London, March 28 to April 2. The economy of movement provided by electrical methods compared to hand operation will be shown visually by means of interlacing wires on the lines of motion-study diagrams commonly used in industry, in the case of three typical industrial operations—a hand-operated bench drill in use alongside a motorized drill, a pair of hoists—one hand-operated, the other motor-driven—used for lifting heavy parts from a factory floor, and a hand-saw and a motorized saw shown in use for trimming boards.

Cost and Works Accountants' Dinner

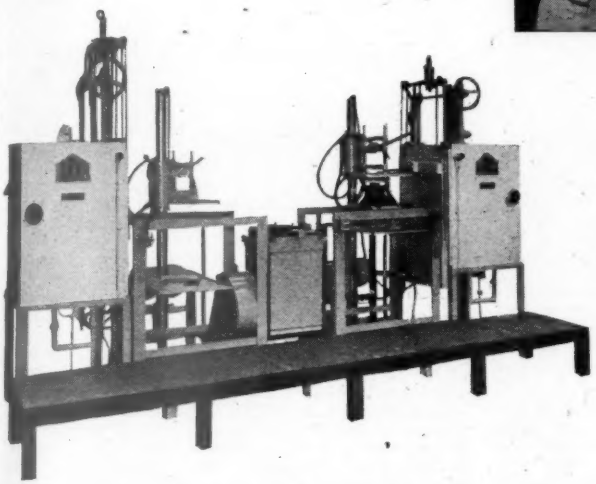
Britain may be forced out of world markets through high-priced exports unless production soars with wages, and workers co-operate with managements in attempts to cut manufacturing costs, said Mr. W. E. Harrison, president of the Institute of Cost and Works Accountants at a dinner of the Birmingham branch of the Institute on March 24. If Britain hoped to achieve its aim of doubling the standard of living in the next 25 years, it must export more and more, he said. Margins of profit had been too small in the past. It was up to managements to act immediately on advice provided by accountants. Proposing the toast to the Institute, Mr. J. Edward Belliss, managing director of Belliss & Morcom, Limited, agreed that manufacturing had often been commenced with profit margins which did not provide for errors and unforeseen events.

Mr. Belliss said he was disturbed at suggestions that the so-called monopolies and restrictive practices in industry in this country should be even more thoroughly investigated than had already been done by the commission set up for the purpose. Managements felt that the emphasis placed by the commission on costs was out of keeping with the developments over the past 50 years from which had evolved the present system of price agreements and carefully regulated trading.

Mr. H. P. Court, a member of the National Council, proposed the toast to the City of Birmingham and the Lord Mayor, Alderman J. R. Balmer, replied. The toast to the guests was proposed by Mr. J. A. Cope, president of the Birmingham branch.

Shell Moulding in 3D

The Shelmolda 'Altus' will handle patterns up to 13in. in height or depth and therefore will provide a greater variety of sand/resin moulds than any other machine on the British market. All the main operations are carried out mechanically and the minimum of physical effort is required from the operator.



The Shelmolda "Altus" (patent applied for)

Capacity

Effective pattern plate sizes of 16in. by 16in. and 16in. by 12in. Handles pattern plates 13in. high or 13in. deep in each oven. Will produce from split pattern 26in. overall. Oven opening adjustable up to 16in. above or below centre line.

Operation

Semi-automatic, with everything at all times under operator's full control. Oven doors, dump box and receptor pneumatically operated. Adjustable ejector mechanism. Investment time electronically controlled. Gas or electric ovens.

May we send you further particulars?

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AP 236-72

CO_2 Process

Dr. Waldemar Schumacher, of Concordiahutte, Bendorf-Rhein, a pioneer of the CO_2 process, is of the opinion that the concerns seriously using the system would not lightly abandon it. He records the following observations:—

Two problems in particular have arisen:—

(1) From the point of view of the opponents of the process, it is asserted over and over that the sand cannot be re-used owing to the sodium-carbonate build-up. A series of trials which he had carried out show that the sodium-carbonate content varies between 0.05 and 0.25 per cent. If the sand is subject to regular control, *i.e.*, compression strength and permeability are checked daily, there should be no objection to adding a certain proportion to the new sand, or putting it with the backing sand. Naturally, it is essential that the sand be milled before use—as indeed with any sand.

(2) It is frequently stated that knocking-out of CO_2 sand incurs difficulties owing to the greater hardness of the cores. A graph (not reproduced here) for a CO_2 sand, showing the effect of temperature on the strength properties of the sand, demonstrates that both shear- and bending-strength reach a minimum value between 400 and 700 deg. C., a fact which, above all, should make it possible for light-metal founders to apply the process to an increasing degree.

At temperatures of 1,000 and 1,100 deg. C., the values for shear- and bending-strength are much higher, so that shake-out has to be assisted by means of suitable additions to the sand (core-breaking materials). The use of these materials is thus necessary for grey iron, particularly. At the higher temperatures used for steel very much lower strength values have been registered.

Problem in Stress-relieving

One of the more unusual techniques, designed to solve problems in the testing of atomic power station plant and equipment, was carried out recently at Calder Hall (Cumberland), the site of what will be the world's first full-scale atomic power station. The problem was how to "stress relieve" the reactor casing, a cylindrical vessel 40 ft. in diameter, 60 ft. high, and weighing 400 tons, made by Whessoe, Limited, Darlington. As there was no gas-heated furnace sufficiently large to take the vessel, it was decided to heat it electrically. A network of stainless-steel tubing 2,000 ft. in length was installed inside the vessel. A heavy electric current was passed through this framework which was raised to red heat.

It took several days to raise the temperature of the steel walls of the vessel to the required temperature, at which the vessel was maintained for some hours to complete the stress-relieving operation. Thereafter it was allowed to cool very gradually to normal temperature. In order to conserve heat and, even more important, to ensure that the thick shell reached a uniform temperature at all points, the whole of the outer surface of the vessel was covered with insulating material several inches thick. The operation was successful, and the reactor casing is now ready for its final test by air pressure.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, Trafford Park, have sent us a copy of their "Girl Calendar."

Aluminium's Expansion at Kitimat

Productive capacity of the aluminium smelter at Kitimat in British Columbia is to be expanded to 330,000 tons a year, more than double the capacity now in operation or under construction. The president of Aluminium, Limited, Mr. Nathanael V. Davis, has announced in Montreal that his company is to spend $190,000,000 on the programme which will be largely met out of the company's own resources.

The estimated cost of the programme includes some further expansion of aluminium facilities in Jamaica, which will be in addition to the immediate expansion announced earlier this month to 300,000 tons a year—an increase of 70,000 tons.

The present installed capacity of the Kitimat smelter, which came into operation last August, is 91,500 tons a year. A further 60,000 tons capacity was authorized last October and is now under construction, while the new programme will add a further 180,000 tons. Total new construction under way or scheduled is for 240,000 tons capacity. By the end of 1956, 90,000 tons of this will be in operation, bringing total installed capacity to 181,500 tons. The balance of 148,500 tons will come into operation in stages.

Shipments of Canadian aluminium to both the US and the UK are expected to reach new records next year.

Insignia Award in Technology

Amongst the special awards which have been conferred by the Council of the City and Guilds of London Institute in respect of the year 1955 to persons of distinction in their industry who, in their early days, gained City and Guilds Certificates or equivalent qualifications is Dr. L. Aitchison. At the age of 17 he passed the City and Guilds' ordinary examination (equivalent to the present intermediate) in Iron and Steel Manufacture in the first class, and was awarded the third prize of the Worshipful Company of Ironmongers, and the Institute's bronze medal. In the following year he obtained a first class in the Honours Examination (equivalent to the present Final) and was awarded the Ironmongers' second prize and the Institute's silver medal. He was largely responsible for the preparation of the report of the joint committee on metallurgical education entitled "The Education and Training of Metallurgists," and until his retirement was Professor of Industrial Metallurgy at Birmingham University. Since 1952 he has been City and Guilds' examiner in subject 14—Section F—Manufacture and Treatment of Non-ferrous Metals and Alloys, and is acting as assessor for appropriate candidates for the Insignia Award.

Changes of Name

Among the companies which have recently changed their names are those listed below. The new titles are given in parentheses.

ALWAYS WELDING CONSTRUCTION, LIMITED, Ashe Works, Ash, near Aldershot (Always Welding, Limited).

NORTH DURHAM MACHINERY COMPANY, LIMITED, 23, Mosley Street, Newcastle-upon-Tyne (Nordurmac, Limited).

JAMES EVANS & SON, LIMITED, Victoria Works, Bromford Lane, West Bromwich (Wire Drawers (Midlands), Limited).

ELECTRICAL MEASURING INSTRUMENTS COMPANY, LIMITED, 16, Fourth Avenue, Hove, Sussex (Emicol, Limited).

BOURNEVALE ENGINEERING COMPANY, LIMITED, Gem Works, Minerva Road, London, N.W.10 (M.C. Ritchie, Limited).

W. D. R. (NOTTINGHAM), LIMITED, engineers and machinists, etc., of 9, Derby Road, Nottingham (H. S. Rowe & Partners, Limited).

POLFORD FOUNDRY PLANT

LIP AXIS TILTING FURNACE

Illustration shows 600 lb. capacity

★ **Rapid Melting**

★ **Low Maintenance, depreciation and Operating Costs.**

★ **Most makes of Crucible may be used.**

★ **No special Foundation required.**

RANGE OF SIZES—250-1,200 lbs.

OPERATION—Push Button, reversing and inching control; automatic "cut-out" insuring against an "over-run" of the Tilting mechanism.

DRIVE—Worm reduction by means of "Brook" totally enclosed electric motor incorporating precision chain drive. In cases of electric failure may be hand-operated.

CONSTRUCTION—Fabricated from Mild Steel; "Preheater" top allows maximum metal to be charged. Drop bottom door allows quick release of metal if pot bursts.

LINING—A rammed lining of Carbofrax packed by a superior monolithic insulating material. Special linings supplied to meet particular specifications.

FIRING—

COKE—Includes low pressure fan with direct drive by totally enclosed "Brook" electric motor. A Damper, regulating air supply is incorporated.

GAS—Efficient Gas Burner with control gear, including High Pressure Fan with direct drive by totally enclosed "Brook" electric motor. Secondary air is provided by directly driven low pressure fan and "Brook" totally enclosed electric motor.

OIL—A proprietary Burner with good "turn down" range and complete control gear.

Includes air supply by fans as in the case of gas firing specified above.

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POL/13

Raw Material Markets

Iron and Steel

Current demands for pig-iron indicate the extent to which all sections of the foundry trade are now employed. Orders on hand are heavy and new business is plentiful, which confirms the opinion that a record production of castings can be achieved this year, provided that sufficient quantities of raw materials are secured. Most foundries, however, have difficulty in obtaining the required supplies of pig-iron in the grades and to the analyses which enable them to work most economically.

The enginering and speciality foundries have good order-books and bright prospects of a continuance of business at least on the present scale for a period ahead, but for some time now they have not been able to obtain sufficient quantities of the pig-irons of their choice, namely, the low- and medium-phosphorus grades. Other irons which they can utilize, including hematite and refined grades, are now so heavily in demand owing to the shortage of the low- and medium-phosphorus irons, that most producers are unable to book the tonnages called for, except for deferred delivery at a rate based on previous usage. Hematite makers are committed for their outputs for some weeks ahead by the orders already on their books, and some refined-iron makers have booked so heavily recently that they are unable to promise delivery of new business under six to 12 weeks from the date of ordering.

The supply of high-phosphorus pig-iron to the light, jobbing, and textile foundries, while not so difficult as for other grades, is barely sufficient to meet current consumption requirements. Work at these foundries is maintained at fairly good levels. There is considerable improvement in the demand for castings for domestic equipment, and the building trades call for a fair tonnage. Most producers of the high-phosphorus grades of pig-iron have plenty of orders on hand, and some have a backlog to overcome.

The steelworks readily accept all available supplies of basic iron, and their production needs call for larger quantities. Stocks of both foundry and steelmaking grades are negligible and outputs are loaded direct from furnace pig beds to trucks.

The dearth in the supply of scrap is also a drawback to foundry operations, some areas suffering more than others in this respect. Most grades of cast-iron scrap are scarce, but there is a pronounced shortage of the better and heavier grades.

In spite of the continued increase in steel production in this country, demand still exceeds output, and with consumers showing no sign of reducing their requirements, makers, faced with accumulating backlogs, are having to restrict the tonnage they are prepared to accept for forward delivery, particularly as regards medium joists and channels. Re-rollers' order-books also are full and their problems is still to secure adequate supplies of semi-finished steel.

Non-ferrous Metals

Production of crude copper in the United States showed some improvement in February, according to the Copper Institute in New York. Output reached 99,500 short tons, an increase of 3,700 tons over January, but the output of refined was about 700 tons down, at 123,200 tons. Deliveries of refined copper to consumers, excluding stockpile deliveries, were 108,500 tons, which showed a drop of 5,450 tons on January. Stocks of refined copper in producers' hands amounted to 44,580 tons at the end of February, compared with 45,980 tons a month earlier.

Outside the United States production of crude copper increased by 5,200 tons to 115,150 tons, while the output of refined improved by 14,000 tons to 89,700 tons. Deliveries were 116,800 tons, a gain of 3,800 tons, while stocks of refined dropped sharply from 159,300 tons at January 31 to 144,335 tons at February 28. Considering that February was a short month, these figures are encouraging. The increase in production outside the States reflects the improvement in the Rhodesian strike position during February. Deliveries were the best since last June.

Apart from copper there was little change in values on the London Metal Exchange last week, but lead and zinc lost ground somewhat. Trading was mostly quiet: dealing in copper livened up considerably on Friday when the news came through that a strike had broken out at the Chuquicamata property in Chile. It is understood that about 4,000 men were involved and the loss to production will be considerable. At midday on Friday when the cash price was under pressure the backwardation in copper narrowed to around £5, but in the afternoon the trend was reversed and a sharp advance occurred as a result of which the week saw a gain of £7 10s. in both cash and three months. The backwardation was then out to £10 again.

Tin also improved on the week, cash closing £2 up and three months 30s. Zinc lost ground to the extent of 20s. for prompt and 15s. forward, while lead closed 15s. down for second half March and 12s. 6d. lower for second half June.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* March 24, £356 to £357; March 25, £357 to £357 10s.; March 28, £359 to £360; March 29, £364 to £365; March 30, £365 to £365 10s.

Three Months: March 24, £347 10s. to £348; March 25, £351 to £352; March 28, £351 10s. to £352; March 29, £355 to £356; March 30, £357 to £357 10s.

TIN, Standard—*Cash:* March 24, £713 to £714; March 25, £715 to £716; March 28, £717 to £719; March 29, £717 10s. to £718; March 30, £715 to £715 10s.

Three Months: March 24, £714 10s. to £715; March 25, £716 10s. to £718; March 28, £718 10s. to £719; March 29, £718 10s. to £719; March 30, £716 to £716 10s.

LEAD—*Second half March:* March 24, £104 to £104 5s.; March 25, £104 5s. to £104 10s.; March 28, £104 to £104 5s.; March 29, £104 5s. to £104 15s.; March 30, £103 15s. to £104 5s.

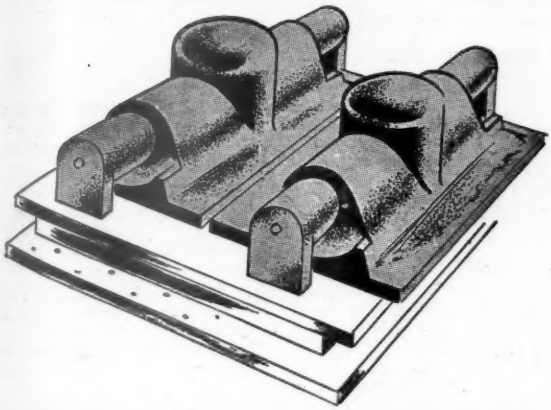
Second half June: March 24, £103 to £103 5s.; March 25, £103 10s. to £103 12s. 6d.; March 28, £103 5s. to £103 10s.; March 29, £103 15s. to £104; March 30, £103 5s. to £103 15s.

ZINC—*Second half March:* March 24, £88 to £88 5s.; March 25, £88 to £88 5s.; March 28, £88 to £88 5s.; March 29, £88 to £88 2s. 6d.; March 30, £88 2s. 6d. to £88 5s.

Second half June: March 24, £86 15s. to £87; March 25, £86 15s. to £87; March 28, £86 15s. to £87; March 29, £86 15s. to £87; March 30, £87 to £87 5s.

COMMENT on the unsatisfied demands for juvenile workers in foundries is made in the annual report of the Staffordshire Education Committee's Youth Employment Service for the year ended July 31, 1954. "The continued lack of recruits to the foundry industry will have a serious effect in the future," the report states, "and it is a situation which undoubtedly must be considered very soon by all those concerned with training within the industry."

'FULBOND' 2 in oil-bonded cores



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1% Fulbond 2 replaces 10% natural sand

★ **PERMEABILITY**

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

March 30, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £15 12s. 0d.; Birmingham, £15 5s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 13s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £18 9s. 3d.

Scotch Iron.—No. 3 foundry, £18 2s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £20 4s. 0d.; South Zone, £20 6s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £21 1s. 6d.; South Zone, £21 4s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £18 2s. 6d.; Scotland (Scotch iron), £18 9s. 0d.; Sheffield, £19 7s. 6d.; Birmingham, £19 14s. 6d.; Wales (Welsh iron), £18 9s. 0d.

Basic Pig-iron.—£15 15s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £40 15s. 0d., basis 45 per cent. Si, scale 15s. per unit; 70/84 per cent., £63 0s. 0d., basis 75 per cent. Si, scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £161 0s. 0d. to £165 0s. 0d. per ton; 38/40 per cent., £258 0s. 0d. to £262 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 16s. 0d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 19s. 0d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £80 0s. 0d. to £82 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit; over 6 per cent. C, £78 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; 2 per cent. C,* 1s. 10d. per lb. Cr; 1 per cent. C,* 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 11d. to 2s. 1d. per lb. Cr; 0.10 per cent. C,* 1s. 11d. to 2s. 2d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 7½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £259 0s. 0d. to £265 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £54 15s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 5s. 0d.; tested, 0.08 to 0.25 per cent. C, £26 5s. 0d.; hard (0.41 to 0.60 per cent. C), £27 10s. 0d.; silico-manganese, £34 10s. 0d.; free-cutting, £29 6s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 17s. 0d.; silico-manganese, £34 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 13s. 6d.; basic, hard, over 0.41 up to 0.60 per cent., C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 15s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £33 11s. 6d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 19s. 6d.; flats, 5 in. wide and under, £31 19s. 6d.; hoop and strip, £33 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £34 5s. 0d.; black sheets (hand mill), 17/20 g., £43 13s. 6d.; galvanized corrugated sheets, 24 g., £55 4s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £54 7s. 9d.; nickel-chrome, £76 7s. 9d.; nickel-chrome-molybdenum, £86 8s. 6d.

NON-FERROUS METALS

Copper.—Cash, £365 0s. 0d. to £365 10s. 0d.; three months, £357 0s. 0d. to £357 10s. 0d.; settlement, £365 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 4½d. per lb.; rods, 401s. 9d. per cwt. basis; 20 s.w.g., 433s. 0d. per cwt.

Tin.—Cash, £715 0s. 0d. to £715 10s. 0d.; three months, £716 0s. 0d. to £716 10s. 0d.; settlement, £715 10s. 0d.

Lead (Refined Pig).—Second half March, £103 15s. 0d. to £104 5s. 0d.; second half June, £103 5s. 0d. to £103 15s. 0d.

Zinc.—Second half March, £88 2s. 6d. to £88 5s. 0d.; second half June, £87 0s. 0d. to £87 5s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £119 0s. 0d.; rolled zinc (boiler plates), all English destinations, £116 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £103 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 8½d. per lb.; rods, drawn, 3s. 6d.; sheets to 10 w.g., 347s. 0d. per cwt.; wire, 3s. 3½d.; rolled metal, 332s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £224; B6 (85/15), £308; BS249, £238.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £265; HTB2 (38 tons), £277; HTB3 (48 tons), £285.

Gunmetal.—RCH, 3/4 per cent. tin. —; BS1400, LG2 (85/5/5/5), £301; LG3 (86/7½/2), £309; G1 (88/10/2/½), £384; (88/10/2/1), £374.

Phosphor Bronze.—BS1400, PB1 (AID released), £398 per ton.

Phosphor Bronze Strip, etc.—Strip, 485s. 0d. per cwt.; sheets to 10 w.g., 508s. 6d. per cwt.; wire, 4s. 11½d. per lb.; rods, 4s. 4d.; tubes, 4s. 2½d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 1½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 6½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 5½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £169 0s. 0d. Nickel, £519 0s. 0d. Aluminium, ingots, £163 0s. 0d.; aluminium bronze (BS1400), AB1, £343; AB2, £353. Solder, brazing, BS1845, 2s. 9d. lb.; granulated, 3s. 0d. lb.

* Average 68-70 per cent.

Forthcoming Events

APRIL 4

Institute of Vitreous Enamellers

Southern section:—Annual general meeting followed by "Establishment and Importance of Intermediate and Final Inspection," by A. Biddulph, 7.15 p.m., at the Howard Hotel, Norfolk Street, Strand, London, W.C.2.

APRIL 5.

Institute of British Foundrymen

Birmingham and West Midlands students' section:—Annual general meeting, followed by "Handling a Reject Casting," by W. T. Wakeman, 7.15 p.m., at the Dudley and Staffs. Technical College.

Incorporated Plant Engineers

London branch:—"Application of Gas Turbines to Industrial Duties," by G. B. R. Feilden, M.A., M.I.Mech.E., 7 p.m., at the Royal Society of Arts, John Adam Street, Adelphi, W.C.2.

APRIL 6

Institute of Industrial Supervisors

Glasgow section:—Discussion course on "Modern Foremanship," 7.30 p.m., at the Institution of Engineering and Shipbuilding, 39, Elmbank Crescent.

Institution of Production Engineers

Halifax section:—"Production of Modern Electric Washing Machines," by J. Senior, 7.30 p.m., at Collinson's Café, Crown Street.

APRIL 7

Institute of Industrial Supervisors

Rotherham section:—Industrial film show, 7.30 p.m., at the Park Gate Iron & Steel Company, Limited.

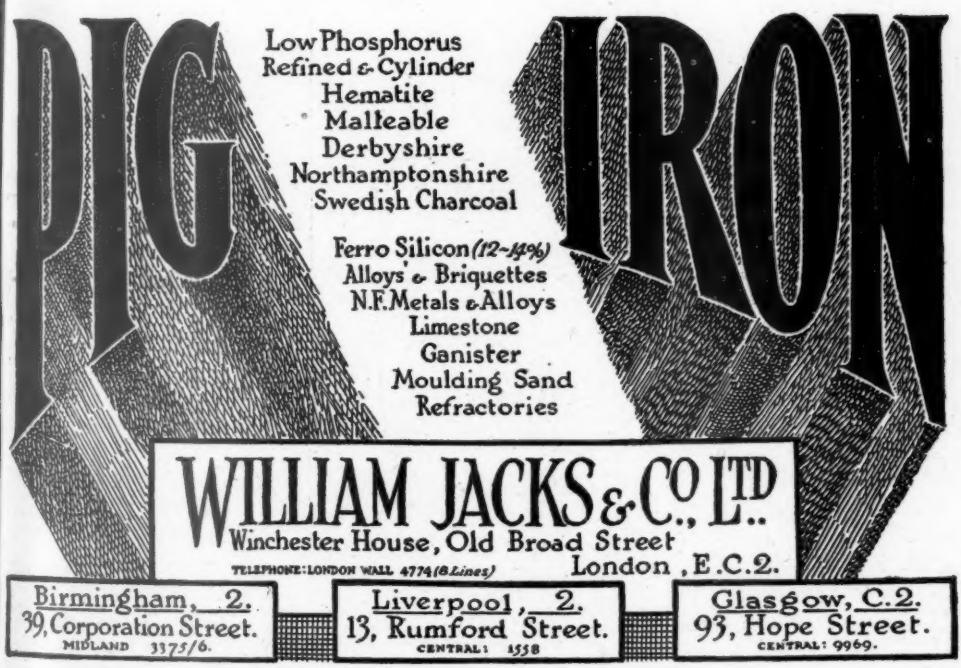
Overseas Trade Inquiries

Details of trade inquiries made by companies overseas concerning British manufactures are given below. Unless informed otherwise, interested manufacturers are advised to communicate (by air mail if stated) with the inquirer at the address given. At the same time they are requested to notify the local overseas representative of the UK Government, whose address is also given below, of any action taken. Any correspondence with the Export Services Branch of the Board of Trade, at Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, extension 776), should bear the appropriate BOT reference, which is quoted in parentheses at the end of each inquiry.

THE MARKETING OFFICER (WOOL), PUNJAB, 11, Egerton Road, Lahore, Pakistan, wishes to import before June a variety of textile machinery. Notify the UK Trade Commissioner, PO Box No. 287, National House, Bank Square, The Mall, Lahore. (ESB/5817/55.)

F. W. MILLING & COMPANY, LIMITED, 9, Broadway, PO Box 6, Port of Spain, Trinidad, wishes to represent UK suppliers of galvanized iron sheets, plain and corrugated; galvanized wire and barbed wire; galvanized wire netting; woven wire; wire nails; bar and sheet iron; galvanized water pipe; black and galvanized malleable iron pipe fittings; galvanized buckets; cast-iron soil pipes; and welded wire fabric. Notify the UK Trade Commissioner, Colonial Building, South Quay (PO Box 225), Port of Spain, Trinidad. (ESB/5785/55.)

A DISAPPOINTMENT was caused by the newspaper strike to members of the Slough section of the Institute of British Foundrymen last Friday. For their first social function, dinner had been arranged in London, to be followed by visits to see newspaper printing in Fleet Street (two parties of 15 members each). This last part of the programme was cancelled at short notice owing to the strike. However, the dinner arrangements were carried through at the Slough Estates Club in Berkeley Street.



CLASSIFIED ADVERTISEMENTS

PREPAID RATES: Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Number 2s. extra (including postage of replies).

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, John Adam House, 17/19, John Adam Street, Adelphi, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

EXPERIENCED Foundry Supply and Equipment SALESMAN, willing to make investment in Company, seeks permanent position. South of England territory preferred. Box EF128, FOUNDRY TRADE JOURNAL.

ADVERTISER with own patterns and having valuable old established connection supplying considerable tonnage to customers of repetition iron castings, 3 cwts.—2 tons each, which are very plain, compact and not machined, seeks post or arrangement with foundry interested in making these. Lancashire area preferred. Replies treated in strictest confidence.—Box AW175, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN desires post, Midlands; 45, M.I.B.F., Grey, high duty, non-ferrous, jobbing, semi, full mechanisation. Technically trained, metal, cupola, sand control, etc. Accept full responsibility; available short notice. Box FF181, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER desires change. 30 years' experience in steel jobbing and mechanized plants. Modern technique, developments. Box DC143, FOUNDRY TRADE JOURNAL.

ENGLISHMAN (28), *returning G.B. late March*, requires progressive position in patternshop or foundry. Patternshop apprenticeship. Last positions held: foreman patternmaker, assistant foundry manager. Wide practical experience in marine, jobbing, domestic appliance and class work. Full technological city and guilds foundry practice and patternmaking (silver medallist). A.M.I.B.F. Mech. eng. qualifications, also. Box ER109, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (35), eight years' supervisory capacity mechanised plant, desires appointment as Progress Chaser or Technical Representative. Good appearance and address. Used to handling correspondence. Box FF166, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order,* 1952.

FOUNDRY METALLURGIST required for progressive Malleable Iron Foundry, near Wellington, Shropshire. The position calls for a Metallurgist with ability to control technical processes in the foundry. The successful applicant will require to have a strong personality, ability to see that routine control tests are thoroughly carried out and the results obtained used effectively. Please give complete details of experience, also age and salary required. Box FM171, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

PATTERNMAKERS required, used to first-class Wood and Metal work. Excellent conditions, canteen, music while you work, etc., top wages and bonus, by the oldest (85 years) established firm, with the absolute highest reputation. Main suppliers for many years to all firms of importance in the entire country and the finest Plant and Equipment in the world.—Apply WRIGHT & PLATT, LTD., the World's Largest Engineering Patternmakers, Irving Street, Birmingham. Vacancies at Manchester branch. Apply Springfield Lane Works, Salford, 3.

REPRESENTATIVE required for all types Castings and Forgings, Engineers' Office, Ealing. Trainee also considered. Box RR170, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT for aluminium sand foundry in Midlands. Age about 35. Salary about £1,000. Box FS169, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (SENIOR) required for large semi-mechanised iron foundry in the Glasgow Area. Superannuation scheme: good salary offered to successful applicant. Reply to Box FF172, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited for our vacancy for a male CHIEF ASSISTANT METALLURGIST, preferably aged 30-40, with experience in Chemical Analysis, Physical Testing and Metallography. Knowledge of Physics (especially Optics) Machine Shop Practice, Heat Treatment of Steel and Instruments Design, an advantage. Works trained man with degree preferred. Apply in writing with particulars, and salary required to THE PERSONNEL MANAGER, Ransomes Sims & Jefferies, Ltd., Orwell Works, Ipswich

TEXTILE MACHINERY MAKERS, LTD., want a GENERAL MANAGER for their subsidiary company, Platts (Barton) Ltd., Urmston, Manchester. The post has very considerable scope and offers excellent opportunities for promotion: salary would be in relation to qualifications and the considerable responsibility of the position.

Applicants should have strong engineering qualifications and good knowledge of modern foundry practice: an engineering degree is preferable although not essential, but successful experience in management and administration is necessary: only men of outstanding calibre and record will be considered.

Applications will be treated in strict confidence and should be made direct to the MANAGING DIRECTOR, Textile Machinery Makers, Ltd., Hartford Works, Oldham, and marked "General Manager." They should give age, full details of previous experience and references which will only be taken up by agreement.

SITUATIONS VACANT—*contd.*

IMPORTANT Australian Ironfounder seek services of specialist in light cast ing and enamelling, with particular reference to problems involving both sc tions. Engagement would be of a tem porary nature, with duration up to twelv months. All expenses paid and liber remuneration. Particulars to Box IA FOUNDRY TRADE JOURNAL.

K. & L. STEELFOUNDERS AN ENGINEERS LIMITED, Letch worth, Herts, require a CHIEF METAL LURGIST to head routine and developme laboratories serving large scale foundr and engineering activities. The post i an important one and highly paid. Th department is well equipped and has fun tional responsibilities in the productio organisation. Applications are invite from experienced and qualified men wh wish to join a team of enthusiastic enqu tives in a progressive company. Applic tions (which would be treated in str confidence) should be addressed to th MANAGING DIRECTOR.

TEXTILE MACHINERY MAKE LTD., require an experienc FOUNDRY MANAGER for their ass ciated company, National Machine Manufacturers, Ltd., of Thana, near Bo bay, India. The person appointed mu be capable of taking complete charge a mechanised plant in addition to ess mechanised and floor moulding. Th year contract, three months leave, fi class passages, including family. Provide Fund, free housing and medical attenti Minimum salary Rs. 1,750 per month, al allowances. Replies to THE SECRETA Textile Machinery Makers Ltd., Hartf Works, Oldham, marked "Foundry."

PATTERNMAKER working Under-for man required. Experienced in fir class metal patternmaking.—Apply WRIG & PLATT LTD., Irving Street, Birmingham.

CHARGEHAND FOREMAN required produce ferrous and non-ferrous cas ings. Applicant should have considerab foundry experience and capable of build ing up staff and handling semi-skille labour. Some knowledge of shell mouldin an advantage. Birmingham district Application in writing, stating age, experi ence and salary required. Box CF167, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN. Senior Fore man required for progressive grey iron light castings foundry in the Mid lands. Experience in floor plate, core making and mechanised plant, an advan tage. Excellent prospects for advancement Please apply to PERSONNEL OFFICER, Box FF161, FOUNDRY TRADE JOURNAL.

LABORATORY ASSISTANT required to take charge of Cupolas producing Grey and High Duty Iron, also Sand Control. Applications stating age, qualifica tions and experience. Box LA162, FOUNDRY TRADE JOURNAL.